Engineering News-Record

A Consolidation of Engineering News and Engineering Record
McGRAW-HILL COMPANY, INC.

April 18, 1918

APR 22 1918
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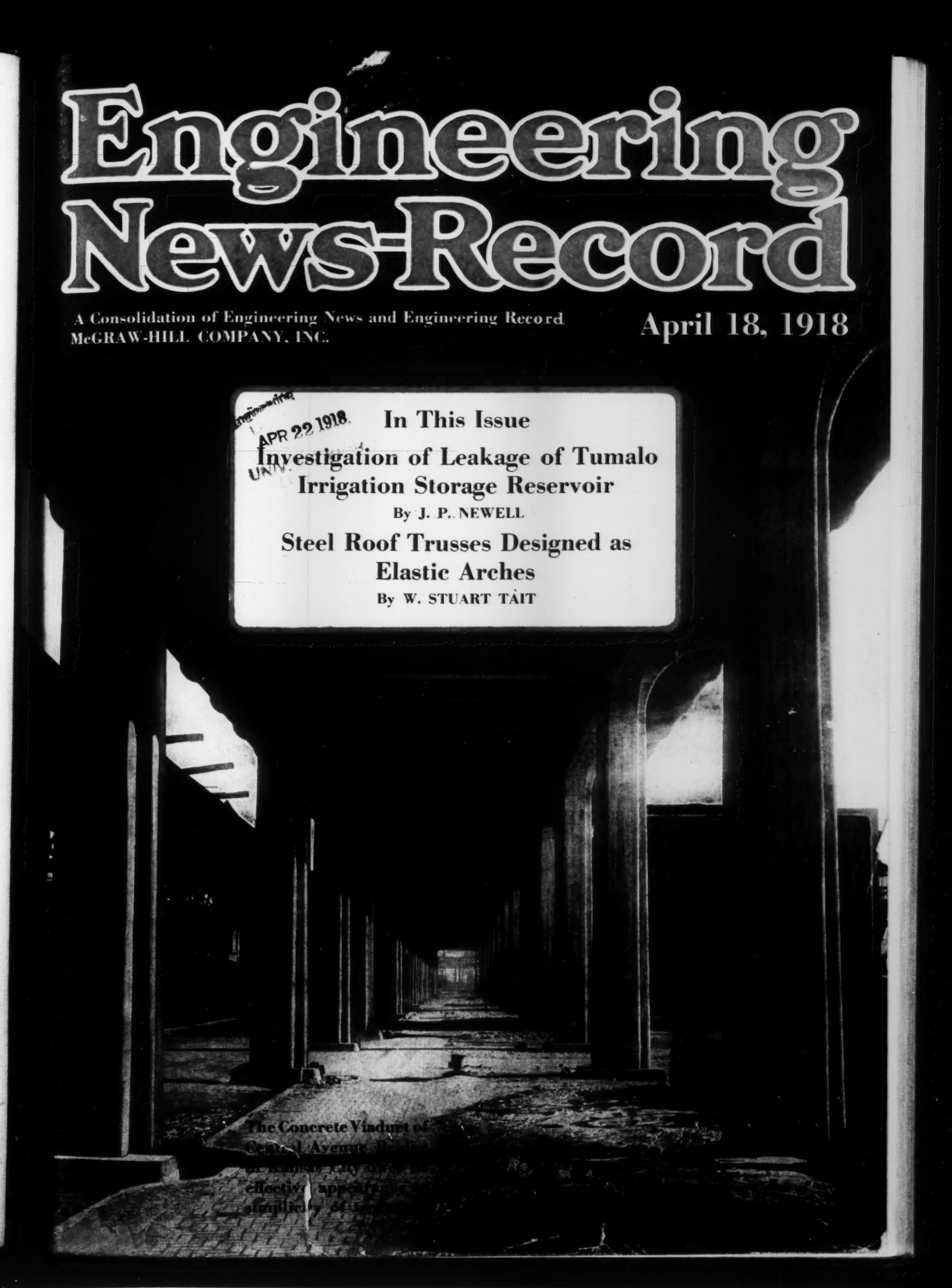
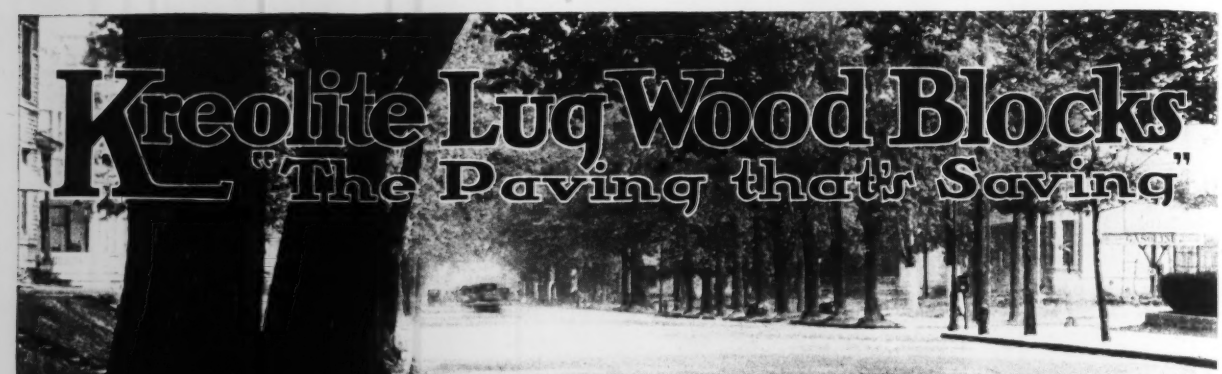


The Concrete Viaduct of
Central Avenue
in Kansas City
effective appearance
simplicity of

Kreolite Lug Wood Blocks

"The Paving that's Saving"



There's no destructive push from these blocks —Look at curb alignment!

This picture was taken several years after the laying of the Kreolite Lug Wood Block Pavement on Jefferson Ave., Toledo, O. The blistering sun of summer and the frosts of winter have both worked their will on this pavement.

Sunshine, rain, snow and ice have alternately contracted and expanded it. Yet the **perfect alignment of the curb** shows how effectively the **lugs** on the blocks absorbed all expansion —eliminated side-push—and preserved a smooth, even pavement surface. And, not only that, but the lugs provide just enough space between the blocks to afford horses perfect foothold.

"The Lug makes a good block better."

50% of orders received in 1917 were repeat orders.

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ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL
DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. Mehren, Editor — Charles Whiting Baker, Consulting Editor

Volume 80 — NEW YORK, THURSDAY, APRIL 18, 1918 — Number 16

Chamber of Commerce of the United States

THOUGH the annual meeting at Chicago last week was only its sixth, the Chamber of Commerce of the United States has won for itself a place as the foremost agency for expressing the voice of American business. Its management has been so excellent that the Government coöperates with it freely, calling upon it for many services that would be onerous were they not for the public welfare. Good citizens everywhere have reason to feel gratified at the position it has won in these six short years.

Business and the War

NO ONE needs to be told that the business men of this country are in this war wholeheartedly. Even so, the meeting of the Chamber of Commerce of the United States at Chicago last week was an inspiration. It showed the length and the breadth and the depth of the coöperation which industry is affording the Government. It gave a birdseye view of unnumbered activities; it put one in possession of such a wealth of detail regarding the agencies at work that one felt that more could not be done. As one man said in discussing Government contracts, though he believed that the allowance of a reasonable profit was for the best interest of all, he was ready to deliver his product on any contract at any price the Government named, at cost if need be, or even at less than cost. That is the feeling one brought away from the meeting—that the Government has but to ask, business will respond.

Production the Engineer's Work

AMERICA'S spirit is beginning to show itself. Read the determination shown in these headlines, from a New York paper of recent date—characteristic of headlines all over the country:

"Prepare to Call 1,500,000 More Under New Draft—Army Officials Expect to Have 3,000,000 Under Arms Within a Year—New Tonnage Obtained. President Is Resolved That Reinforcements Shall Be Poured Into France. Camps to Be Kept Full. Men to Be Sent to Them for Training as Fast as Quarters Are Ready."

We are not sparing our manhood. We are in this fight to win, and no stone will be left unturned to do it. Shall we back those men? What an answer comes from every American heart! The way to back them is by money, first, but fundamentally by tool power—by engineering. Tremendous production, that is the slogan; tremendous production of ships and transportation, of farm and factory products. And production is the engineer's job—our job. Those boys in front are, above all, the consumers of the material which our engineers will furnish.

Shall we, the engineers, be found wanting? Shall civilization fail because we have gone down to defeat? Again the answer—this time from the engineers of the nation—is equally clear and carries a note of defiance.

Three-Hundred-and-Sixty-Five-Day Roads

AGAIN we are witnessing the spring breakup—not of the ice in our rivers, but of the roads. The stream quickly resumes the normal, the ice is swept out, no damage has been done. The highway, on the contrary, is ruined. The surface has been broken through; that which was a road is now a plague of ruts. If this applied to the byways it would be bad enough. But it is true of trunk highways too. Commerce is stopped and the war congestion on the railways becomes worse. Year after year we have endured this condition, but the war has given us a new point of view. In normal times we stopped road transportation; we endured the condition because we did not realize that it increased the cost of living. Now war sternly forbids the interruption of road traffic—and there is developing with tremendous strength a demand for "365-day roads." They must come. They are an essential of the trunk-road policy of the future—yes, and of these war times.

Earth Fill Pressures Can Be Measured

HOW inadequate were the provisions in both the Necaxa and Calaveras dams for the measurement of the degree of solidity in the clay cores of hydraulic-fill earth dams was remarked in last week's issue, although it is evident that upon this solidity—which is in turn tied up with the speed of the clay deposition—depends the safety of the dam during construction. In this issue is published a suggested method not only for the determination of the drying out of the core but of the more important pressure conditions inside the dam. The tests conducted by the Office of Public Roads lack something of practicality in resemblance to dam construction in that there is no simulation of the drying out by drainage through the rock fill of the dike. Thus they offer little indication in themselves of the proper speed of construction or of the effect, observed at Necaxa, of a surface drying alongside the rock fill with consequent slowing down of the evaporation and drainage inside the fill. The main importance of the tests as thus far reported is in their indication of the possibility

of measuring the pressures inside the dam with considerable accuracy. With this assured there is no doubt that the Miami conservancy dams for which the tests were initiated may be so closely observed during construction as to make remote the possibility of the fatal slippage of the protecting dike.

Building Code Progress in Sight

WITH a modern building code under consideration in Hartford, there is renewed prospect that in measurable time all cities and towns of importance will have come into line. It is surprising that a city of more than a hundred thousand population exists today with a building law suited to only village requirements —but it is true of Hartford. And, as an indication that the conditions demand a code of highest grade, an office structure of some five hundred feet height is being erected there at present. Modernization lags surprisingly, at times, in some one department of a community. Baltimore until a few years ago managed to exist without a sewer system, though since then it has built a remarkable network of sewers and a great sewage disposal plant. The opportunity is now at hand for Hartford to retrieve its reputation in a similar way.

Engineers and Civic Affairs

IF MORE engineering societies would follow the plan of looking into every vital subject on which they are competent to pass an opinion legislative and executive bodies would soon begin to take heed of them. As it is they come so infrequently before these bodies that not much weight is given to their recommendations. The societies must learn that it is necessary to be constantly on the lookout for new propositions and get a word in on them early. Once known as the watchdog of actions on engineering subjects their chances for success are doubled. The Engineers' Society of Western Pennsylvania has chosen an opportune time to launch its work on civic affairs, as noted in the Society Service column in this issue. Engineers in Chicago last week let the Civil Service Commission know they were watching its actions when a committee of influential engineers waited on it to protest against placing an engineering position outside of the "Engineering Service." In the latter case not much satisfaction was obtained, as the commissioner, so one of the committee relates, did most of the talking. The answer is to keep at it, and to make early failures serve as aids to future endeavors.

Mayor Hungers for Health Bureau Heads

DISORGANIZATION of the health department of New York City by the abolition of seven of nine bureaus and the placing of the work of these seven bureaus in charge of the five borough sanitary superintendents is threatened. Such action, affecting directly the health of 6,000,000 people and indirectly the health of many millions more, would be a national calamity. It would also be a blow to good municipal government and a gross injustice to the heads of the seven bureaus, including workers of such world-wide reputation as Dr. William H. Park, chief of the bureau of laboratories, and Dr. S. Josephine Baker, chief of the bureau of child hygiene. The ostensible object of the abolition of these bureaus is that they are not authorized by the city charter. If this is the real question at issue why refuse the medical and civic organizations admission to the "private hearings" on this matter being conducted by the civil service commission and the commissioner of accounts? The belief of these organizations and the public press is that the move is prompted solely by politics. The secret hearings give added reason for that belief. The new health commissioner, Dr. J. Lewis Amster, has a fine chance to stand up for the public health, and to render valuable professional service, even though he risks his position to do it.

Labor, and Again Labor

NO SUBJECT recurred so frequently at last week's meeting of the national Chamber of Commerce as labor. One heard it in the presidential address, in the great speeches by Secretary Lane, Secretary Daniels, and the Earl of Reading, in a number of committee reports, in sessions devoted to the industrial situation and in those given over primarily to quite foreign subjects. There were progressive views, and some that were radical; conservative views and some wherein the old antagonism was struggling to the surface. The speakers divided easily into two classes: those with courage who faced the facts and were willing to strike out and against the opposition of their own friends advocate with hope and confidence a forward-looking policy; and those who reluctantly admitted that some steps had to be taken to meet a serious situation, but grudingly fought concessions every inch of the way. While both classes were heard—the extreme conservatives trying to camouflage their toryism by sounding occasionally a progressive note—we believe that the sentiment of the gathering, so far as it was given expression, was decidedly progressive. Possibly Dr. Marshall's repeated thought that labor must be regarded and studied as a factor in production—a truly engineering conception—would have received the approval of a very large majority had there been opportunity to register the sentiment. The outlook, therefore, for an intelligent consideration of the labor problem would be most encouraging if those in attendance at Chicago were truly representative. As a matter of fact, though, we believe them to be the progressive element in the industrial world. The conservative element is not so ready to enlist through chambers of commerce in community service. Nevertheless, the fact that so large an element in the business world is forward-looking is significant of the changing sentiment.

Highway Industries Association

HENRY G. SHIRLEY'S selection as secretary of the Highway Industries Association is evidence of the high purpose which animates that new but already influential body. Mr. Shirley comes to the new position with a reputation as one of the ablest highway engineers of the country. His work has shown a remarkable grasp of the highway as an instrumentality of transportation, not a mere dead structure consisting of subbase and foundation and surface. Maryland's road

system, under his jurisdiction, justly acquired a national reputation. The trucking system there developed and the road legislation have also set excellent standards.

As its executive officer Mr. Shirley will now bring the talents so well exercised as state highway engineer of Maryland to the problems of the Highway Industries Association. That body, bringing together for the first time all the agencies interested commercially in the construction and use of highways, can, if operating under a high purpose, contribute much to the development of a sound public opinion on highway matters, while its resources will permit the gathering of data on road work not hitherto brought together and digested. Moreover, such a body mobilizes the highway industries of the country and makes their combined resources available immediately and effectively for any service the country may require. That, in fact, was the reason for its formation—to mobilize for war service.

War-time coöperation at once showed the wider possibilities, and the inevitably permanent character of the organization was at once seen. Mr. Shirley's selection is the surest evidence that the association could give to engineers, contractors and the public of its high purpose, of the standards which will control its work. With his guidance, the pledges of support already received and the heartiness with which government agencies have accepted the association's offer of assistance, its success is assured.

Integrating the Profession

THOUGH passed at the January meeting of the board of direction, it was not until the March *Proceedings* of the American Society of Civil Engineers was published that it became known publicly that the board had taken a stand against the organization of an "Academy of Engineers" as proposed in a bill now pending before Congress. The resolution declares it the opinion of the board that such an academy "if there is a field for its activities" should be organized under the initiative of the national engineering societies and that it "should not be made up by self-appointment." In the second contention the action of the board will have the support not only of engineers but of the country at large. These certainly are not the days for the perpetuation of undemocratic and aristocratic ideas. With the world fighting for democracy, the engineers surely are not of tune with the world movement in asking Congress to authorize a self-perpetuating aristocracy. We cannot conceive that the man who has penned those wonderful messages to the world, asking that America spend its last dollar and the last drop of blood to make the world safe for democracy, should sign a bill of such autocratic character. The other thought put forth by the board, that such an academy, "if there is a field for its activities," should be a part of the super-organization now being developed by the national engineering societies, also deserves full and hearty support. The Engineering Council represents a movement that should result in integrating the profession. Part of that integration certainly consists in arranging for the recognition of those who have achieved eminence in the profession. But with no less certainty, and this the board needs equally to recognize, it demands recognition of the needs of those who are just entering the profession and even of men who can hardly be dignified by the name of engineer but who are associated with engineers and who regard themselves as engineers. While the board protests, therefore, against the establishment of a body of super-engineers independent of the national engineering societies, it needs to consider why the rate of increase of juniors in the society has diminished since the year 1907 and why the total membership of juniors has grown less for each of the last three years. It needs to revise, too, the conclusions of its recent committee suggesting the postponement of the establishment of a student membership. The profession needs integration. It will not be integrated so long as the struggling young men at the bottom are neglected.

"For God's Sake, Hurry Up!"

IN AN address, to the national Chamber of Commerce at Chicago, which showed more plainly than any other recent public utterance the extreme gravity of the shipping situation, the Hon. Crawford Vaughn, until recently premier of South Australia, used these last words of Joseph H. Choate to impress his hearers with the seriousness of the case. His figures show that, counting on America to send abroad and maintain only 1,500,000 men and on the cutting in half of submarine sinkings, the Allies must build not less than 10,500,000 tons of ships this year. Great Britain can build 420,000 tons a month. The production of neutrals will be negligible. We can build 750,000 tons a month after we get started—but, as the speaker pointed out, it does not appear likely that we will get started till very late in the year. America will do well, Mr. Vaughn stated, if she builds 3,000,000 tons this year.

This does not mean that America will do well. It means that unless something happens to increase our production, we shall have done exceeding ill. We may have lost the chance to bring the war to an early end.

In the face of these facts it was brought out at the convention that existing shipyards are realizing only 50% efficiency. If their production could be doubled, the tonnage might be made up. Speaker after speaker told the convention that labor was not to blame for this inefficiency. Partly it is due, they stated, to training new men. Partly it has been due, one or two of them admitted, to bad management. Largely it is known to be due to conditions which have surrounded labor at the yards and which are fast being remedied. How much it is due to lack of scheduled planning for the prompt delivery of ship material as needed, no one ventured to say. On the other hand, no one conversant with the facts would deny that this cause has been perhaps the most serious single drawback to the rapid building of ships. Is it being remedied? Do the builders and the Shipping Board know yet whence and when their materials will arrive? Have the chances of delays and upsets been reduced to the lowest terms?

As was shown editorially in these pages last week, this kind of planning is the concern of engineers and construction men. Developed by them, and applied by

them to the affairs of more than one Government department with good results, it requires the engineering type of mind to utilize it to advantage. Whether we build ships of steel or wood or concrete, such methods would produce the ships. We have the lumber mill and fabricating capacity—every harbor on the coast is a potential concrete shipyard—labor skilled at building trades and easy to train at shipbuilding is available by the hundred thousand and straining to get at the task—and yet a foreign statesman can come to our country, study our progress and say with truth that we "will do well" if we build only a tonnage which will fall so far short of the needs as to threaten the defeat of our arms.

How much longer must we wait before making full use of the kind of engineering planning that will turn out those ships?

An Inspiration for Highway Engineers

HIGHWAY engineers who can not see a great future—a new future—for their specialty after reading the papers in this issue by Roy D. Chapin and Henry G. Shirley had best transfer their energies to other lines. They are out of their element. It is apparent, though, from these papers, that a new point of view is necessary. We have, of course, recognized that the highway was but a track for vehicles, that it had no value unless it were used. At the same time we were wholly concerned with the details of the highway structure and were jealous of its use for fear our pretty surface might be damaged. Our highway attitude has been restrictive rather than expansive. Our only concern was in keeping the road in good condition; and if few vehicles used the road, so much the better, the surface was more easily maintained.

If, however, we had fancied ourselves in the transportation business—as we should have done—if we were selling transportation, we would have welcomed traffic, we would have invited it, we would have planned a stronger and a wider and a better track to entice traffic to come over our line. What would we say to a railroad president who rejoiced in the smallness of his traffic because it saved the roadbed? True, there is another side—the railroad president would not let a 100-ton locomotive on a 50-ton capacity bridge. But if he thought he could develop traffic that demanded 100-ton locomotives, he would be headed toward retirement if he did not soon get the heavier bridge. So, in highway work.

The highway engineer of the future, considering himself in the transportation business, will build the best track that the prospective traffic warrants. In determining the best track, he will develop a new science of highway economics. He was little concerned in the past with the cost of highway transportation, either to the user or to the community which built and maintained the track. These costs will be essential considerations to him in the future, for he will be one of the officers of a transportation business.

The adjustment to the new point of view can come none too soon. We need it now, in these war times. And we shall need it still more after the war, when we shall see a road-building era such as we have never dreamed of hitherto.

Our Military Camps Show Remarkable Typhoid-Fever Record

REMEMBERING the tragic happenings in our military camps during the Spanish-American War, when thousands of men succumbed to typhoid fever, hearty commendation is due all concerned for the remarkably small number of cases of typhoid and related diseases among the troops which have been in our cantonments and camps since last October. The record is certainly one to be proud of. It should give rise to thankfulness as well—double thankfulness, for it means not only that our military forces are not being thinned or even measurably weakened by typhoid, but also that our civil populations have been actually or potentially almost freed from this scourge in the last two decades.

Through the courtesy of Surgeon General W. C. Gorgas, U. S. A., *Engineering News-Record* has been informed by Col. D. C. Howard, Medical Corps, U. S. A., that for the 22 weeks from Sept. 29, 1917, to March 1, 1918, there were, among all the troops in the United States, 121 cases and 6 deaths from typhoid fever, 9 cases and no deaths from paratyphoid, and 289 cases and 2 deaths from dysentery. More than half of the cases of dysentery, about half of the paratyphoid, and one-fourth of the typhoid occurred in October, "or approximately the time of the first occupancy of the cantonments," Colonel Howard states, "so that the majority should be charged to civil communities." Of the deaths from typhoid, three occurred in October, presumably before the men had received the typhoid prophylaxis, and "should therefore be chargeable to civil communities." Of the other three typhoid deaths, two occurred "in soldiers who had received the full prophylactic treatment—two in November and one in January," but "the immediate cause" of the January death was pneumonia.

Official figures of the total number of troops covered by these statistics are not available. Unofficial estimates place the number at 1,250,000 soldiers who have been in or passed through the various camps and regular army posts. This would bring the typhoid death rate well down toward 1 per 100,000! Very few cities can show so good a record.

Although most of the typhoid appeared in or about the first month in camp, and is therefore largely chargeable to the civil communities from which the men came, the low rate reflects well upon the communities, as has already been intimated.

There is no means of telling what percentage of the cases and deaths from the diseases mentioned were water-borne, but making due allowance for infections before reaching camp it would seem that the water supplies there must have been practically free from typhoid infection. In fact, the record indicates as nearly perfect camp sanitation as could be expected. However, a further and more severe test will come next summer and fall. It may be added that there were troops enough scattered through the country during the last fly season to indicate, in the relative absence of typhoid, that the typhoid fly was then kept under control.

The engineers, the physicians, all the officers and all the men in these camps have contributed by one means or another to the wonderful record outlined—and thus to the winning of the war.

Tumalo Irrigation Storage Reservior Leaked Profusely and Erratically

Engineering and Geological Investigation of Site Last Summer at Cost of Less than $5000 Would Have Saved the State of Oregon a Loss of Nearly $200,000 If Made Before Beginning Reservoir Construction

By J. P. Newell
Civil Engineer, Portland, Oregon

THE history of the Tumalo irrigation project contains valuable lessons for promoter, legislator and engineer. Few enterprises of this nature have combined so many varieties of failure with partial present and probable complete ultimate success. The underlying fault was the lack of essential preliminary engineering and geological studies.

The lands of the project lie in the valley of the Deschutes River at from 200 to 500 ft. above that stream and about 3500 ft. above sea level. The irrigation of 27,000 acres was undertaken in 1902 under the terms of the Carey act, the water to be obtained from a small stream known as Tumalo Creek. The lien price was made very low, and a large part of the lands were soon contracted for. Ditches were built and settlers began making improvements.

In 1905, with only 1000 acres irrigated, it was found that there was a shortage of water. That the scarcity was exaggerated is shown by the fact that 12 years' records now show water enough for 5000 acres, but it was evident that serious errors had been made in the calculations of water-supply, and with 20,000 acres under contract the effect on the minds of the settlers can be imagined. The lien price was totally inadequate to meet the cost of obtaining water from any other source, and the company found itself hopelessly bankrupt.

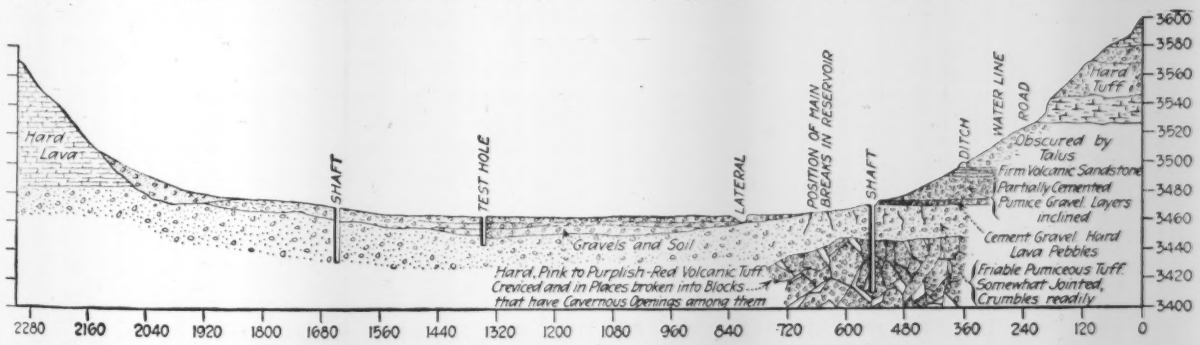
After a long series of quarrels, complaints and lawsuits the Desert Land Board finally consented to an increase of the lien, under conditions protecting to some extent those settlers who had made improvements on their lands, and the project was reorganized. The new company spent considerable money in investigations, and preparations were made for completing the project with a storage reservoir. But about that time the market for irrigation securities collapsed, and no investors could be found to put the project on its feet. Accordingly in 1911 the company conveyed all its rights to the state, which, however, was unable to take over the project, as the Desert Land Board possessed neither authority nor funds to maintain, much less complete it.

Strong pressure was brought to bear on the legislature, and in 1913 an appropriation of $450,000 was made for the completion of the project to the extent of 22,500 acres. The price was fixed at $40 an acre, with allowances to settlers who had made payments to the various companies. It was expected that a profit would result and that the receipts from the sale of lands would constitute a fund for the reclamation of other arid lands.

A feed canal seven miles long, carrying 225 sec.-ft., was constructed, and a dam was built for the storage of 20,000 acre-ft. The summer flow was calculated to be sufficient for 10,500 acres and the reservoir was to be filled during the winter and from the excess flow of the spring months.

Grave doubts having been expressed as to the watertightness of the reservoir, a board of consulting engineers was appointed, who recommended that the dam be constructed to part of its height and a reservoir test made. When it was found that such a test would delay construction beyond the expiration of the two-year period after which the unexpended balance of the appropriation must be returned to the general fund, and that subsequent legislatures might be unwilling to continue the enterprise, the board was induced to recommend the abandonment of the test, and the dam was completed to the full height. The entire appropriation was expended by the end of 1914, and the project finished except a part of the distributing system and some minor structures.

Water was turned into the reservoir and by April 10, 1915, had risen about 20 ft. above the level of the outlet tunnel. On that date a large hole opened up in the bottom, about 1000 ft. from the dam, and a stream of over 200 sec.-ft. escaped through it, speedily emptying the reservoir. This hole was closed by groundsluicing, but as fast as the water rose new breaks oc-



CROSS-SECTION THROUGH TUMALO RESERVOIR THROWS LIGHT ON ITS LACK OF WATERTIGHTNESS
Approximate relations of rock strata 1050 ft. south of dam

curred, and it was found impossible again to bring the water even as high as the first break.

These holes were sometimes 30 to 50 ft. across and 10 to 25 ft. deep. In other cases wells 20 to 30 ft. deep and only 3 or 4 ft. in diameter were formed. Often the ground would drop away with such suddenness that it was unsafe to remain in the vicinity unless armed with a long pole or attached to a rope.

Since most of the holes occurred within a short distance and in nearly a straight line the constructing engineer of the project became convinced that the trouble was due to the existence of a fault, and that it would be practicable to uncover the outlet and seal it.

The funds available having been exhausted in repairs, nothing further was done during 1915 and 1916. In February, 1917, the legislature made an appropriation of $10,000 for the purpose of determining the cause of the leakage and remedying it. A board of engineers, consisting of Fred N. Wallace, manager of the project, Capt. Henry M. Parks, director of the Oregon Bureau of Mines and Geology, and the writer, was appointed to take charge of the investigation.

Another Investigating Board Appointed

As soon as weather would permit observations were begun. With the perversity characteristic of leaky reservoirs, spoiled children and other pets, spectacular outbreaks, such as had been frequent in 1915, refused to occur, but seepage over a wide area was found to dispose of the water as fast as it was received. Especial notice was taken of the effect of the water when it reached the depressions left by former outbreaks, but the only action to be observed was that the water seeped away rapidly from such holes for a few hours and then the flow gradually ceased. When the water covered an area of 30 acres it was found that the loss amounted to from 6 to 8 in. per day, but there was no disturbance of the surface to indicate any spot at which it was escaping.

In order to determine the character of the substrata and to find the effect of previous puddling operations two shafts were sunk in the field where leaks had been most frequent, the first reaching a depth of 22 ft. and the other 66 ft., or 50 ft. below the outlet tunnel. Each revealed a broken and cavernous condition of the rocks, and in the latter, surface soil and pieces of sagebrush were found at various points clear to the bottom. Another shaft was sunk to a distance of 28 ft. near the west side of the reservoir, and several sections were cut through the overlying soil and gravels along the east side by means of water from a ditch carried around the edge of the basin. These were useful in carrying out the geological investigations, which were undertaken by Capt. Parks, with the assistance of I. A. Williams, of the Bureau of Mines and Geology. They report in part as follows:

What the Board Reported

"The geology of a wide area west of the Deschutes River in the vicinity of the reservoir is simple and almost monotonously uniform. The country is a plateau in general, sloping gently to the northeastward and underlaid entirely with flat-lying volcanic tuffs and lavas in which the tuffs predominate. These beds have a total thickness of thousands of feet and are deeply dissected by many stream cañons tributary to the Deschutes River. The volcanic tuffs are made up of the finer fragmental ejecta from the explosive eruptions of volcanoes. They are sometimes composed of partially water-sorted materials; again they seem to have accumulated as wind deposits, and still again resemble lava flows that probably spread out as a sort of bouldery or pebbly lava froth. In every case, however, they are comparatively light in weight and very open-textured, their porosity varying from 35 to 50%. In places these tuffs have been compacted and cemented into more or less firm rock and later have been shattered and broken into joint blocks of varying sizes.

"The most important features on which the conditions at the reservoir depend are, first, the general porosity of the rock underlying the reservoir for several hundred feet. This factor, together with the deep incisions made by the streams in the surrounding territory, have resulted in a lowering of the permanent ground water level to many hundred feet below the present land surface at the reservoir, with the result that the porous substrata greedily absorb water whenever it can be had and pass it on successively to the beds below. The position of the ground water is evidenced by the fact that wells dug in this vicinity are required to go from 300 to 500 ft. to find water.

Remarkably Porous Reservoir Bottom

"Beneath at least a portion if not all of the reservoir bottom is comparatively hard, blocky red tuff, the joint blocks of which are separated from each other in places to such distance that a man can crawl among them, much the same as would be possible in a very coarse talus slope where rocks of large size and many tons in weight have settled apart or moved somewhat upon each other. This broken tuff bed is exposed at places in the bottom and at the sides of the reservoir, though it is usually covered or insulated from the water of the reservoir by from a few feet to an undetermined depth of a light, only partially consolidated pumiceous deposit, and this again is covered in considerable sections of the reservoir bottom by a later superficial deposit of sand, silt and gravels. These latter materials are less pervious than the pumiceous layer and where they exist the water escapes only by excessive seepage. In certain areas of the reservoir, however, the broken tuff is separated from the water of the reservoir only by the light, fluffy pumiceous deposit. One of these areas extends in a northwest-southeast direction along the east side of the reservoir in the approximate location of what has been previously described as the 'fault' line. When the water rises to this height, it readily percolates through the pumice bed and flows away rapidly into the large holes between the joint blocks of the broken tuff below. Experience has shown that it gets away so rapidly that it soon erodes the pumice deposit, washing it down into the cavernous spaces between the joint blocks and making the large holes already described.

Sealing by Sluicing in Soils and Silts Suggested

"Taking into consideration all the conditions, it seems highly probable that if it were possible to raise the water in the reservoir to higher elevations than has yet been accomplished, the difficulties from loss of water by breaking through this soft pumice would increase. It

has been suggested that these breaks or leaks may be sealed by sluicing into them the finer soils and silts in large quantities from the hillside above. It is questionable whether this system of puddling can be depended upon to sufficiently seal all the leaks which may occur. Granting the possibility that a measure of success may be attained by this method, it is our judgment that even after a great amount of sluicing has been done the leakage will still continue in sufficient quantity by slow percolation through these imperfectly sealed breaks, as well as throughout the entire area of the reservoir, where no 'breaks' have occurred, to greatly impair the use of the present site as a storage reservoir."

The board of engineers recommended that no lands be sold beyond the amount irrigable without storage, but that sluicing operations be carried on during the non-irrigating season in the hope that the reservoir may be made ultimately to hold at least a small amount of water. The cost of sluicing will be insignificant compared with the value of even a very small storage.

They were also of the opinion that the project could be watered from the Deschutes River at such a cost that the state might recover the loss sustained through the failure of the reservoir and urged that surveys and estimates be made for such connection.

This unfortunate experience does not constitute a valid argument against state reclamation. Except for the failure of the reservoir, which would have been equally likely to occur under any form of management, the project has been a success. But it does emphasize the necessity for thorough and complete investigation, in advance of construction, of all the conditions attendant on an enterprise involving so many uncertainties as the irrigation of desert lands. No other expenditure is so profitable as that by which an intended investment is shown to be unwise or a proposed structure to be unsuited for its purpose.

The writer has no desire to criticise the management of this enterprise. Under the same circumstances he might have made the same mistake. But it is by the mistakes of others as well as our own that we learn, and the fact remains that the investigation which was carried out last summer at a cost of less than $5000 would five years ago have shown the Tumalo reservoir site unsuitable for the storage of water and have saved the State of Oregon a loss of nearly $200,000.

U. S. Chamber of Commerce Discusses Industrial Relations

Many Speakers Indicate Seriousness of Labor Problem and Several Suggest That Solution Will Be Found in New Order

FROM Secretary Lane, who sees the coming of a new democracy that is social and economic; from R. Goodwin Rhett, president of the chamber; Waddill Catchings; Secretary Daniels; Meyer Bloomfield and Dr. Charles A. Eaton of the Shipping Board; Prof. Leon C. Marshall of the University of Chicago and William H. Vandervoort of the National War Labor Board, the convention of the U. S. Chamber of Commerce in Chicago last week heard the seriousness of the labor situation. Utterances of these men indicate that they look for closer coöperation between employers and labor, and realize the immediate necessity of it if war production is to meet the demands of victory. Several of the speakers paid glowing tributes to the shipyard labor. The extracts given below are from two of the most significant addresses.

New Democracy Seen by Franklin K. Lane

"THE democracy for which I stand and into which we will surely grow is a democracy which is social and economic"; Franklin K. Lane, secretary of the interior, told the convention. The secretary called the attention of business men to industrial changes which he said were resulting from the war and which would greatly improve the economic strength of America. He also outlined a plan to solve labor problems after the war by employing returning soldiers on reclamation work and paying them in lands and houses. His address, quoted in part, follows:

"There are two kinds of men and only two kinds of men in this world at this time, the small men and the big men. The small men are those who cannot see because they have a dollar right in front of their eyes, and the large men are those who can see because they have got a dream in their hearts.

"I do not like to say it, because I think war an awful curse, but good things are to come out of this war, and one of them is to be the purifying of business. It is to be a noble thing, because for the first time, gentlemen of dollars, for the first time you have had a real opportunity to prove that business could be purified through patriotism.

"Our motto and our slogan must be from this time on, Put every dollar to use, put every hand to use, put every acre to use, put every idea to use; because, gentlemen, we have come to the time in the history of the world when we understand that such a thing as property exists only because of use. That which you have belongs to me, in the larger sense. That which you have gained out of the community should be so used as to be of service to the community. The nation is the trustee of great ideas for the world. You are trustees of your property for the world. Regard yourself as a trustee, and you will not go astray in the handling of your property.

"We must think of the day when the men come back, and we must think of the making of America. We must think of a new America, and we must begin with the boys who come back from the front. I say that everyone of those men should have an opportunity to acquire a piece of soil of the United States. I will tell you a plan of reconstruction in this country after the war that will make a great part of this western county useful. We have along the lines of the Colorado River a million or a million and a half acres

which can be irrigated if we will dam that river and develop power and hoist that water onto the mesa. I would take enough men from the returned army to build those dams, to put up that power plant, and I would pay those boys in farms upon the mesa itself. Let each man have his forty acres of irrigated land, with a house, with stock, and let him pay Uncle Sam in labor for it by constructing the works that make it possible.

"I would follow that course along the other rivers of the West in the arid and semi-arid sections. I can give to you 4,000,000 acres of irrigible land if you will give me the hands that will build the dams and dig the ditches. Then I would come to this Mississippi valley. Away below you have 15,000,000 acres of overflowed lands. Build dikes, and save that land, and divide it among the men. In the north you have the cut-over lands and the swamplands. Take them from those who have them at a reasonable figure, pull up the stumps, build houses upon the land, and let the men have forty years in which to pay.

"I do not want to give these men one single thing. Charity—I do not like the word. We want to deal with these men upon plain business grounds, only as giving them opportunity, and unless democracy means opportunity, it means little.

"The one distinction that you can draw between the kind of government that we are fighting and the kind that we live under is the distinction between control, direction, authority, autocracy and individual opportunity. We have our chance. That is democracy. Heretofore that has been represented only politically, but there is another kind of democracy besides political democracy. The democracy for which I stand and into which we will surely grow is a democracy which is social and economic. I do not believe in the theory that all enterprise can be carried on by the government wisely and well, because those of you who have had administrative experience know that managerial ability is rare; that governmental methods are wasteful; that there are things which have been standardized which can safely be left to the hands of government, but that, above all, we must save personal initiative, the inventive power of the human mind. But where a point of standardization has been reached in an industry, why should not government take that industry into its own hand and carry it on? Iit is only a question of governmental efficiency.

"I ask you this question: Even with the governmental inefficiency, gentlemen of commerce, are we not going to take things into our own hands unless business, large business, and small business, gains a real social sense? And what is a social sense? It is the relation between your dollars and my need; between your power and my heart. We cannot have a republic that will be lasting unless you regard me as entitled to a portion of what you undertake to make with your money—a partner with you. Surely it is not so, that there cannot be invented in this world some new kind of coöperation, in which the worker himself can have a part.

"I will live, I trust, to see that day. Man's imagination has not been exhausted yet, and we will come to have a great corporation, a profit-sharing company, in which the man who wants and is willing to work can have an identity of interest with the managerial skill of one man or the capitalistic power of the other man.

"There are great ramifications to this thought, and it is necessary that common sense should be exercised in curbing the power, because when a people collectively get a lust for doing things, they may go dangerous lengths. But work is to make us, as work has made us, and the man who works is the man who is to be master.

This world is the result of work. Our civilization is the result of work. Work all—every one must work, and the pride of America is that we have a smaller population who do not work than any other nation. It is because of our work that we are great. It is to be because of our work in the future that we will be entitled to have anything. So we are going through a real process of evolution, a process out of which will come a new and a better America."

Industry Must Apply Itself to New Problems, Says Catchings

"THE very existence of private property after the war hangs in the balance," said Waddill Catchings. He emphasized the immediate necessity for concerted action to stop all profiteering on war work, pointed out that we are far behind England in planning for reconstruction, and continued in part as follows:

"The continuation of the incentives of personal reward, of individual initiative, hangs in the balance.

"We as business men must apply ourselves to these problems, and in doing that we must apply ourselves in the spirit of the times. Those great forces which are at work are irresistible. They cannot be stopped, but they can be guided. If business men bring their knowledge, their experience and their training to bear on these problems, if they do it in the manifest spirit of the times, they can exercise a far-reaching influence upon what is done. But if they endeavor to apply themselves in these times according to preconceived ideas, without studying conditions as they are, they are apt to be thrown aside and to have no part in the industrial conditions which are created for the future."

Mississippi Has $3,000,000 for Roads in 1918

The Mississippi State Highway Department is preparing standard specifications for road construction, and it is estimated that $3,000,000 is available for road work this season. There is no state-aid system, but the Federal appropriation is shared by the several counties. Roads are usually constructed by bond issues of the counties and road districts. Inability to secure cars and labor has caused many counties to invest their money in bonds pending a change in shipping conditions. The department does not control maintenance. Earth roads are maintained principally by road-graders and drags. Labor is almost impossible to obtain. The department consists of three commissioners and the state highway engineer, Xavier A. Kramer, Magnolia, Miss.

Effective Concrete Architecture in New Viaduct

Designers Avoided Horizontal Lines—Columns of Cross-Shaped Section—No Ornate Details—Construction Methods

SIMPLICITY of outline, and the effect secured by emphasizing vertical lines and subordinating horizontal lines, distinguish the concrete viaduct approaches of the new Central Ave. viaduct across the Kansas River in Kansas City, Kan. Columns of cross-shaped section were used, all breaks of the vertical lines of the columns were avoided, and belt-courses, copings and the like were suppressed so far as possible. Three views herewith show the result. The effect was obtained without resort to ornamentation and involved no extra cost.

The engineers of the structure, Harrington, Howard & Ash, of Kansas City, Mo., say the following about the design:

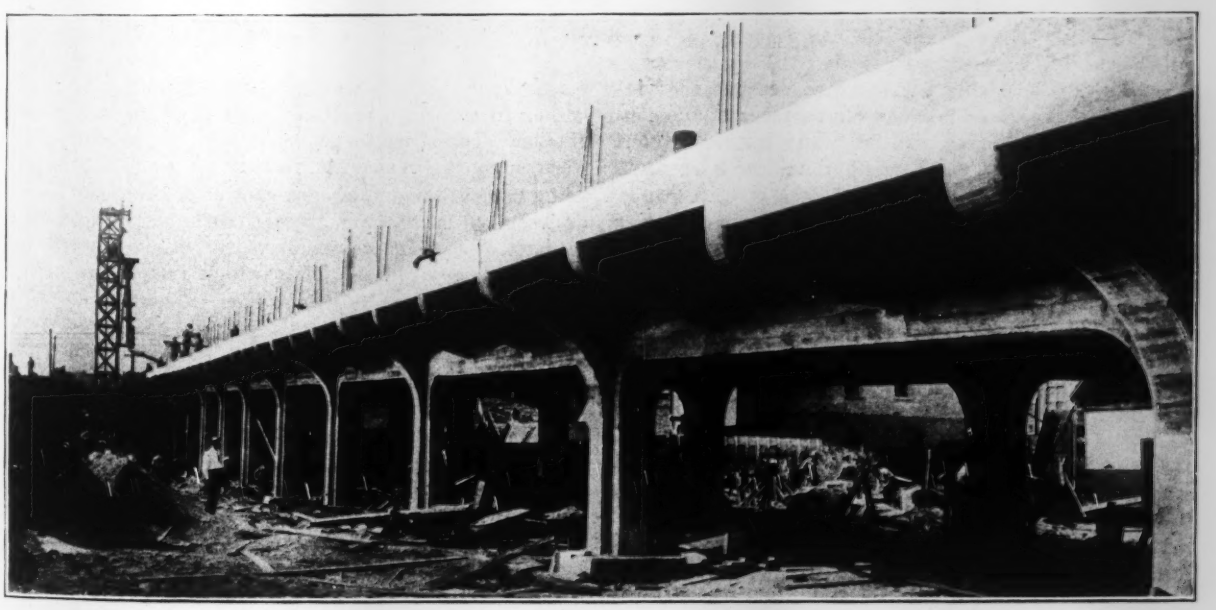
"We have tried to work out a viaduct which would be essentially a concrete structure, simple of design, and not an imitation of stone or brick structures. There were no funds for adornment, and the section of the city in which the viaduct is located would not warrant such ornamentation. The structure is in the vicinity of the stockyards, serum plants, packing plant and railroad yards. It is intended to look as if it were built of a once plastic material, motholithic and continuous, and not made up of separate units or blocks or stone. The lines of the longitudinal girders and of cross-girders are carried down the columns, so that the columns might appear, as they are, actual parts or continuations of the girders and beams. There is no horizontal line breaking the column from its base at the ground surface clear up to the top. Projecting corners are rounded, following the filleting usual in the molds for any poured material. The design is an attempt, therefore, to produce in a modest way a structure pleasing in appearance and obviously suited in design for the material of which it is obviously constructed, without slavish imitation of architectural forms primarily designed for other material."

The Central Avenue bridge comprises three 250-ft. riveted truss-deck spans, carrying two floors. The lower deck reaches the ground surface at the ends of the bridge, but the upper has nearly 2000 ft. of viaduct approach on either bank. The east approach, now complete, extends east in Central Ave. and south alongside James St., both of which are main thoroughfares of the river bottoms.

This right-angle arrangement in ground plan, further complicated by a branch approach turning northward with sharp 180° turn from the portion along James St. to give an entrance on Central Ave., is due to street-traffic conditions, railway track locations, and real-estate questions.

The east approach carries no street-car tracks, as cars run along Central Ave. on an old steel elevated viaduct. The river bridge and the west approach, however, accommodate a double-track line. Partly because the tracks east of the river are to one side of the new roadway approach, the street-car space west of there was placed at one side of and separated from the roadway. The result is that the west approach has the street-car space located centrally over one of the two longitudinal girders, which girder is used also in place of the two inner track stringers. Unsymmetrical deck arrangement of another kind occurs on part of the east approach, where there is a footwalk at one side of the roadway, and in consequence the loading on main girders and cantilever brackets is different for the two sides of the structure.

In spite of these and other complications of arrangement, symmetry and unity of external appearance are preserved very successfully. Unfortunately, about half of the west approach was built of steel, in the expectation that the other half, which was to be paid for by the



MIXER AND TOWER ON SLED SUPPLIED CONCRETE FOR ENTIRE SUPERSTRUCTURE

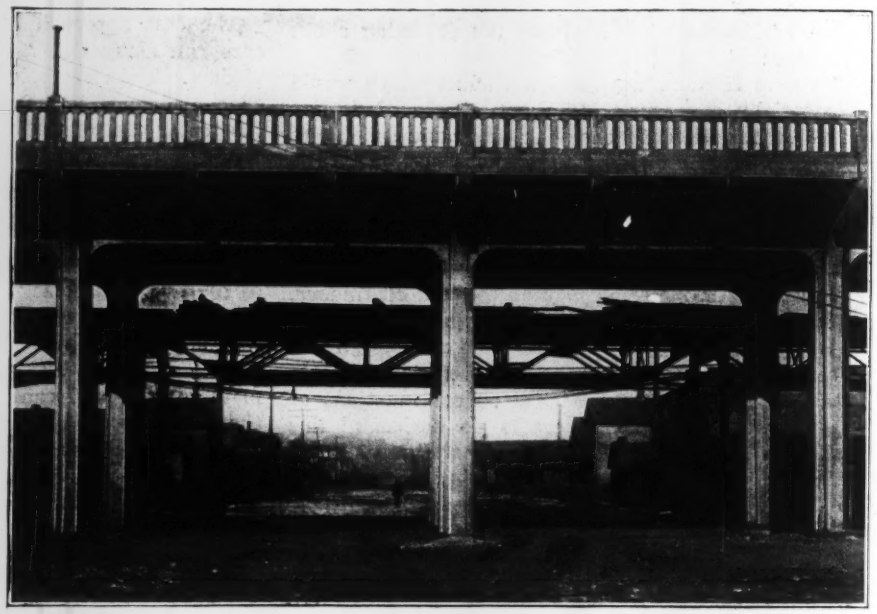
railways which it crosses, would be built of steel, for economy. But when, after delays in calling for bids on this latter part, it was ready for contracting about the end of last year, prices had shifted so greatly that a concrete structure was cheaper. On redesign the contract was let recently for completing the west approach in concrete.

The spans of the concrete viaduct range from about 30 to 50 ft., as local conditions required; the normal span is 40 ft. Columns are 30 x 36 in. to 36 x 36 in. over all, measured at the top, from which point each face batters outward ¼ in. per foot. The corners of the cross-section are notched out about 6 in., making the column cross-shaped, as though made of two overlapped rectangles about 2 x 3 ft. These rectangles have constant width from top to bottom of the column, producing two vertical lines between the outer battered lines.

The main girders are 24 in. wide by 5½ ft. deep. The panel length between floor-beams averages 10 ft., which distance is spanned by a 9-in. floor slab.

Expansion joints in the longitudinal girders, occurring three to four spans apart, have upper and lower steel sliding plates, each anchored into the concrete, with a sheet of lead between. The lead is intended as means of adjustment when the girders deflect, and also as means of preventing rusting on setting of the joint.

As one of the views shows, a very simple railing is used. While effective, it lacks all effort at ornate effect. The same avoidance of ornament is obvious throughout the design.



LOCATION OF VIADUCT DID NOT WARRANT EXPENSIVE ORNAMENTATION

Methods of forming and concreting are specially worth notice because the viaduct is of low cost and because the surfaces of the concrete were left as they came from the forms, without any artificial finish. The form marks show in close-up view only.

The pedestals, supported on Raymond concrete piles driven about 20 ft. in fine sand (to a penetration of 1 in. in four to six blows), were concreted by a one-bag mixer driven by a gasoline engine and mounted on wheels. This mixer was shifted about 200 ft. at a time; it discharged directly into wheelbarrows in which the concrete was wheeled to place. The crew consisted of eight men and handled about 40 cu.yd. of concrete per day. With everything moving smoothly this concreting crew could fill the piles and pedestals just about as fast as the piles could be driven, and hence worked continuously immediately behind the driver.

After the pedestals were concreted the column reinforcement was put in place and wired securely to the dowels projecting from the pedestal. This consists of twelve vertical bars—three in each face—and two sets of tie bars, each spaced 15 diameters of the bar. A light movable scaffold was used for the erection of the column steel; in order to allow adjustment of the reinforcement to fit accurately within the forms the two sets of tie bars were wired to each other only at the top, which could readily be reached after the forms were in place. The column forms, set after the steel was in place, were of 2-in. tongue-and-grove lumber and were the same as would be used for a square column, with the addition of a beveled box in each corner to make the cross shape. They were built in two halves so that they could readily be placed around the steel, and extended only up to the beginning of the knee-bracket curve. As the viaduct was begun at the lower end, it was necessary to provide new forms for each column, which made the form cost rather high.

The curved work of the cantilever beam bottoms and girder knee-brackets was carefully cut out and put together in the form shop, situated near the end of the viaduct. The other forms were built in the field. They were supported on posts resting on mudsills, a post being used at the end of each cantilever beam and others as required along the cross-girders and longitudinal girders. The plank centering of the floor slab was supported on longitudinal joists which rested on vertical studs on the sides of the beams. These studs were independent of the verticals on the beam forms, so that the latter did not have to be disturbed when removing the beam forms. To prevent sag due to settlement, the girder forms were raised one-half inch at the middle above the required elevations; the results were very satisfactory.

To give the rounded corners on columns, girders and beams, a cove molding was placed in the forms. This had a radius of 2 in. and was cut out of 1-in. stuff, being therefore rather thin and difficult to handle. To prevent bad warping it was necessary to use an unusual number of nails. Placing this molding properly

VERTICAL LINES OF COLUMNS A PROMINENT FEATURE

around the short curves at the ends of the cantilever beams and around the curves at ends of girders and cross-girders was a matter of only a little practice. By cutting the back and side of the molding every few inches the carpenters soon became expert and produced a very satisfactory job.

The reinforcement generally was assembled in place. The steel for the first few girders was also assembled in place, but as the girders were deep and narrow this was slow and difficult, and thereafter the girder reinforcement was assembled complete immediately above the forms and then lowered into place. This assembling was done for three or four spans, the distance between expansion joints being supported on joists spanning the girder form.

Usually the entire structure between successive expansion joints (three or four spans) was concreted continuously. This does not include the columns, which were filled up to the beginning of the knee-bracket curve on the day preceding the general concreting.

The large view herewith shows the tower which was used for pouring all concrete. This tower, with mixed and hoisting equipment, was mounted on a large sled, and was moved alongside the structure as the work progressed. Switch tracks were adjacent to the viaduct for much of its length, and the sand and rock could therefore be delivered very close to the mixer. The material was in general shoveled direct from the cars onto shoveling platforms composed of old steel scrap plates; the mixer was charged with barrows, a short timber incline being moved along with the sled to provide an easy runway. Cement was stored in a warehouse at one end of the viaduct and hauled by wagon to the mixer.

The cost of the new bridge comprises the following items: River bridge, $320,000; east approach and alterations to old street-car viaduct, $168,000; steel portion of west approach (700 ft.), $112,000; concrete portion of west approach, about $250,000. The total cost thus will be about $850,000.

The east approach is by far the lowest in cost per foot, because it carries only a 30-ft. roadway and a 6-ft. sidewalk. For this part the unit costs are:

Concrete, 0.5 cu.yd. @ $8.75	$4.38
Concrete, 2.6 cu.yd. @ $10.80	28.08
Steel, 470 lb. @ $0.04	18.80
Piles, 8.75 lin.ft. @ $1.35	11.81
Handrail, 2 lin.ft. @ $2.25	4.50
Lighting	1.22
Pavement, 3.33 sq.yd. @ $2.95	9.82
	$78.61
Incidentals	0.94
Engineering, 5%	3.98
Cost per linear foot	$83.53

The extreme westerly part of the structure, that which is now under contract, is being paid for jointly by the city of Kansas City, Kan., and the railways whose tracks are crossed by the viaduct. All of the approaches east of this part, including the river bridge, were paid for by Wyandotte County.

Expansion Joints Found Necessary in Concrete Revetment

CONCRETE-SLAB bank protection on the Missouri River buckled because of the absence of expansion joints at right angles to the shore line. In later work along the same section of improvement ½-in. expansion joints were provided every 50 ft. along the paving.

The revetment comprises a willow brush mattress 86 ft. wide, under water and extending up the bank to a point 6 ft. landward of the low-water line, a pavement of 2 x 2-ft. precast concrete slabs 4-in. thick on a 10-ft. width at the low-water mark, and cast-in-place pavement of 8 x 8-ft. slabs 4 in. thick on the upper part of the bank. The small slabs were molded with loop inserts of ⅜-in. galvanized sand, by which the blocks were fastened together to make a flexible mat. The 8 x 8-ft. slabs were cast in alternate 8-ft. strips running up the bank. In concreting these strips, joints parallel to the shore were made by setting plastering laths between the curb boards set along the sides of the strip; as soon as the concrete was in place and smoothed off the joints were cut through down to the laths with a roller cutter. The second set of strips, between those first concreted, required no forms, the concrete being simply placed against the finished pavement, this forming construction joints, but without space for expansion.

The work described was done in the season of 1912, and during the hot weather of 1913 the pavement buckled up at about 1000 ft. intervals. It was necessary to cut the joints at the buckles to let the slabs settle down to their original positions.

G. C. Haydon, assistant engineer, who described the work in the March-April number of "Professional Memoirs" of the Engineer Corps, U. S. Army, gives the cost of the revetment work on three different sections, 7000 to 12,000 ft. long, as $7.58 to $8.13 per lineal foot. This includes wire-mesh reinforcement in the 8 x 8-ft. slabs. Since the 1916 season, however, this reinforcement has been omitted, as it is believed to be unnecessary.

Cost Curve of Highway Maintenance Has Well-Defined Minimum

Maryland State Traffic Studies Indicate That the Necessary Expenditure Per Ton Hauled Over Roads Depends Upon Its Total Amount and the Type of Tire Used on Vehicles

By H. G. Shirley
Chief Engineer Maryland State Roads Commission, Baltimore

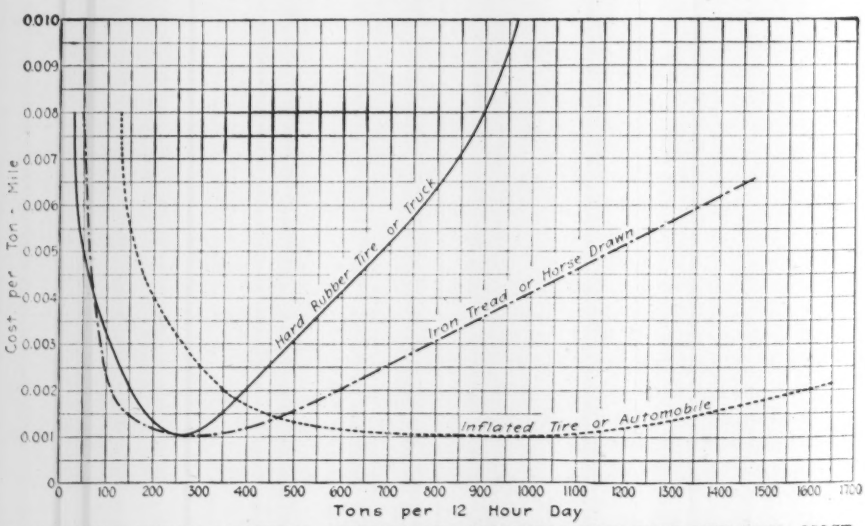
WHILE the State Roads Commission of Maryland has always been reluctant to state the cost of maintaining roads per ton-mile per year for any particular stretch of highway, the averages for 1916, covering the variegated types of road throughout the state as well as varying traffic densities, are susceptible to analysis in such a way that some interesting facts become apparent. For instance, irrespective of the type of tire used upon the vehicle, the minimum cost per ton-mile runs about $0.001—although the density of traffic resulting in a maintenance cost of this amount varies from 250 tons per 12-hour day, if hauled on steel or hard-rubber tires, to as high as 900 tons per 12-hour day if carried on pneumatic tires. While the exact industrial and economic significance of these figures is somewhat veiled because of the fact that the pneumatic tire traffic is preponderantly that of passenger or pleasure automobiles, the indications can be safely used in selecting the type of construction and predicting the probable cost of maintenance when building new or improving old highways.

For many years Maryland has been employing the patrol system of maintenance. While experiments have been made with the gang system and while even now the gang is used to supplement the patrol system, the universal use of this latter method has given the roads commission an ideal agency through which to accumulate data of the character necessary for road design on a thorough engineering basis. For the state patrol men not only count traffic but also make measurements of road wear. At first each patrolman made a traffic record of his own section—at one place today, at another the next. The results of this haphazard arrangement were insignificant and led to the establishment of permanent places on the sections where traffic counts should be taken. Furnished with a printed traffic sheet, a patrolman with only an ordinary amount of intelligence can keep accurate records.

Supplementing these reports, another employee of the roads commission goes about from place to place wherever the patrolmen's reports indicate variations which cannot readily be explained. In most cases this man will find it necessary to take a day's count at the points where the records of the patrolmen are in question. Traffic records are thus obtained for certain definite points on the state highway system. In the study of the wear suffered by the road due to the traffic indicated by the count, bench marks were established at either side of the road at these points. These bench marks are established and two pipes are driven to the same elevation, one at either side of the road. By stringing a light line with a weight at either end across these pipes, measurements could be taken to the road surface by means of a foot rule, and are recorded for each 2 ft. across the road's width.

When these measurements first were taken no attention was paid to the air temperature or other possible causes of variations in elevation. But in some cases it was found that, after additional surfacing had been put on, the elevation of the road surface was lower than was indicated by previous reading. A study showed that temperature and other atmospheric changes had a material effect on the elevation of all types of road surfacing. So at the present time thermometers are furnished to each observer, and the reading is noted on the data sheet along with a brief description of the general atmospheric conditions. While no conclusive data have as yet been gathered and while no definite conclusions can at present be stated, it is felt that there is a chance that this method will result in a usable basis of comparison between traffic density and road wear.

So far it seems quite certain that bituminous mats suffer little wear. On the other hand a good deal of internal wear seems to result from the passage of traffic composed largely of heavy trucks. This type of vehicle



DIFFERENT TYPES OF TIRES AFFECT THE MAINTENANCE COST PER TON—MOST ECONOMICAL TRAFFIC SHOWN BY MINIMUM POINTS

seems to grind together the stones of the macadam crust.

Digressing for a moment from the main subject of this paper, I would like to mention that the roads commission intends in the near future to build a macadam road in the construction of which each item will be weighed. For instance, the limestone base will be carefully weighed and covered with a layer of traprock, which will be weighed, and bound together with screenings whose weight also will be known. After a year or so of use, the road will be taken up and the several types of material entering into its construction will be weighed again and the loss or change in weight determined. This should give a fair indication of the yearly internal wear.

Such in brief have been and are the attempts to determine by direct measurements the wear which results from a measured volume of traffic. In the analyses which have been made of the cost per ton-mile per year the actual cost of maintenance, as shown by budget and balance, has been used. This has been considered, of course, against the indications of the traffic counts.

Three Classifications Employed

In studying the density of traffic, three classifications have been employed: Horse-drawn vehicles, or those with iron tires or treads; pneumatic-tired vehicles; and vehicles, mostly motor trucks, equipped with solid-rubber tires. Of course the weights of the vehicles in the several classes are roughly determined, mainly through experience and observation, and these weights combined with the classification according to the nature of the contact between vehicle and road have resulted in data which should allow a fair prediction of what maintenance should cost, and how much material should be put upon the road each year to carry a certain volume and classification of traffic. Knowing this in advance, it should be possible some day to so provide maintenance that a road would never be worn out, strictly speaking, but would be brought back during the year to a condition closely approximate to that in which it was at the time of its construction. While the matter of internal wear figures in this in a way which cannot be definitely stated at this time, it seems probable that, by strengthening weak spots and installing tile drains and other drainage facilities where moisture conditions seem bad, at some near date the matter of road maintenance will be put on a strictly scientific basis.

Although I said at the beginning of this article that the roads commission was loath to give particular data on a specified road in terms of maintenance cost per ton-mile per year, perhaps a few instances which have been checked up to eliminate or weight variations will be indicative of the general character of information resulting from this study.

The road from Belair to Kingsville carries a horse-drawn traffic of about 50 tons per day, a truck traffic of 150 tons per day, while the pneumatic-tired vehicles probably total about 400 tons per day. As may be seen, the amount of traffic is small, yet because this road is in a hilly country and the shoulders are hard to maintain it costs 0.6 of a cent per ton-mile per year, although the roadway is only 14 ft. wide.

Another instance is a road in St. Mary's County, built of gravel and carrying very little traffic. Yet several heavy rains resulting in washouts ran the maintenance costs to the same figure as that in the road previously mentioned, that is, 0.6 of a cent per ton-mile per year. Considering the use that the people get out of this road, it is a very extensive bit of work in spite of its low first cost.

A road which is subject to a fairly heavy traffic leads from Baltimore to Frederick and on into the mountains. Between Baltimore and Frederick there is heavy traffic, mainly consisting of automobiles and heavy horse-drawn vehicles—solid-tire traffic being small. There are two motor trucks running over it carrying freight on one of the Public Service Commission's franchises, but in general there is not a heavy automobile-truck traffic on this section. In some of the mountainous sections there is scarcely any horse-drawn traffic, but traffic of other types runs to a fairly high figure—the automobiles totaling 400 to 500 tons per mile per 12-hour day. The maintenance cost on this road is fairly low, amounting to only 0.2 of a cent per ton-mile per year.

The cost of obtaining data of this nature may seem high in the aggregate, but when it is considered that it amounts only to about $3 per mile per year, the sum is practically negligible in view of the value of the information resulting from it. One of the results of this accumulation of information is shown on the accompanying cut. While no detailed explanation of the curve seems necessary, it is interesting to call attention to the fact that the pneumatic-tired traffic as it increases in volume is not a serious proposition as far as maintenance is concerned. On the other hand, the hard-tire traffic becomes a very serious matter after its volume exceeds 1000 tons per mile per day. A realization of the significance of this factor has caused restrictions as to the weight and width of tires to be incorporated in the motor-truck legislation of Maryland.

It is interesting to note in this connection that because of the reduced speeds enforced when a motor vehicle is equipped with hard-rubber tires, quite a number of concerns and individuals have been experimenting with pneumatic tires in order that they may be enabled to gain that increased use of the truck which would be possible if the maximum speed of 35 miles per hour, which is allowed with pneumatic tires, can be maintained as a working schedule.

Shorten Lincoln Highway in Illinois

A 1½-mile cut-off on the Lincoln Highway route near Elmhurst, Ill., will save about one mile in the 25-mile stretch between Chicago and Wheaton, and will make a 30-mile run without a turn. This will cost $10,000 for grading, $12,600 for bridges and culverts, and $30,000 for 18-ft. concrete paving. The principal structure will be a concrete bridge with five 50-ft. arch spans. Work on this cut-off has been approved by the United States Government and it is to be completed this spring. A wooded tract of 80 acres through which the road passes has been purchased by DuPage County for $16,000 as a forest reserve. A. L. Webster is engineer, and E. L. Gates is county superintendent of highways.

Tests To Determine Pressures Due to Hydraulic Fills

Stability of Dikes Against Thrust of Clay Core May Be Measured by Method Tried Out Experimentally

By A. W. Goldbeck

Engineer of Tests, Office of Public Roads and Rural Engineering, Washington, D. C.

PRESSURES in the interior of hydraulic-fill earth dams have hitherto been indeterminate, although the partial failures of the Necaxa and Calaveras dams have shown the measurement of such pressure to be most necessary. The Miami Conservancy District, which contemplates the construction of five large hydraulic-fill dams, recognized the necessity for knowledge of this character and the coöperation of the Department of Agriculture was requested, utilizing the soil pressure measuring apparatus developed in the Office of Public Roads and Rural Engineering. Preliminary results from the tests indicate that such a method of measurement may be developed.

In order to gain preliminary information on pressures due to hydraulic fills, a laboratory test on a large scale was outlined. In brief, the scheme consisted in filling a standpipe with finely divided clay in the same way that the core of a hydraulic-fill dam is placed. The horizontal and vertical pressures were then to be measured at various heights in the standpipe, so as to obtain an idea of the pressure in the core of a dam at various stages of the fill. Moreover, it was proposed to use this test to try out the soil pressure apparatus for its ability to function over long periods under the very wet conditions existing in a hydraulic fill.

A standpipe was erected at Arlington Experimental Farm. It is composed of four lengths of flanged pipe, 30-in. in diameter and 41.35 ft. in height. On the ground near the bottom of the standpipe was placed a shallow galvanized steel pan about 8 ft. in diameter and 2 ft. deep. This was used for mixing the sand-clay filling material with water so that it could be pumped into the standpipe. For this purpose a hand-driven double-force pump was used. The method of procedure in filling was to place from 30 to 60 shovelfuls of sand-clay in the mixing pan, fill the pan with water, allow it to stand over night, mix it thoroughly on the following day, then pump the muddy water into the standpipe. At intervals of three minutes hydrometer readings were taken on samples of the stream entering the standpipe to furnish an index of the weight of solids pumped. The entering stream was impinged on a baffle board, thus breaking it up into a coarse spray and preventing the disturbance of the clay already deposited. On the following day the clear water above the settled clay was drawn off except for about two feet, and additional muddy water was then pumped in and again allowed to settle over night. This operation was repeated day after day, pressure readings being taken with the buried pressure cells. Holes in the standpipe were provided at intervals of one foot, from which samples of the filling material could be drawn when desired.

TEST TOWER AND METHOD OF SUSPENDING CELLS

The device used for measuring the pressures in the pipe is that already employed by the Office of Public Roads and Rural Engineering for measuring the distribution of pressures through earth fills and back of retaining walls, and described in the 1917 Proceedings of the American Society for Testing Materials in a paper by the writer. Briefly, the scheme of pressure measurement with this apparatus consists of the equilibration of the earth pressure acting on a sensitive cell by means of air pressure within the cell, detection of the instant of equilibration by the breaking of electrical contact within the cell, and reading the air pressure within the cell at that instant by means of an accurate pressure gage. Details of the cell that is buried in the earth and of the indicating instrument at the surface of the earth are shown in accompanying drawings.

In this series of tests a special method was used of making the air pipe connections from the cell in the fill to the indicating instrument at the top of the standpipe. In former pressure measurements in dry fills a single line of air pipe was used. If water should collect in a cell having a single air connection, there is no way of detecting that fact, nor can a correction be made to the pressure reading to compensate for its presence. For this reason a double line of pipe was employed in the present experiments. By removing the screw plug at the end of one of the pipes and pumping air from the indicating box to the cell, the presence of water in the cell will be shown immediately by the air pressure gage in the indicating box, the reading being equal to that of the water column in the pipe connections. The air pressure in the small pipe forces any water that might be present up into the outlet pipe and holds it there, thus eliminating its effect on the pressure readings. By the use of this device, correct readings of pressure may be obtained whether a small amount of water is present in the air line or not.

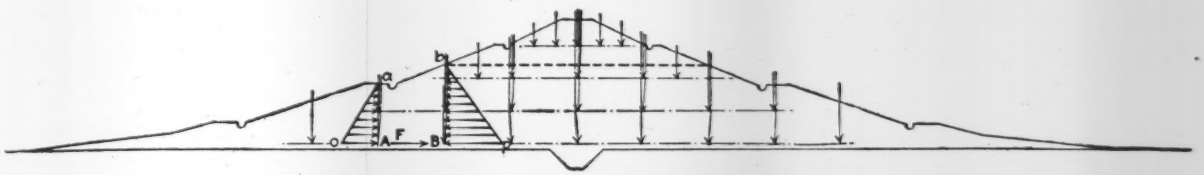
In one of the views is shown the method of suspending the pressure measuring cells in the standpipe. It was thought advisable to permit the cells to sink gradu-

ally as the fill settled so that interference with its free settlement would be as small as possible. To accomplish this object, all cells were hung over pulleys and counterweighted sufficiently to hold them in suspension. In the view is shown also the indicating part of the instrument with its pipe and electrical connections. The cells for measuring lateral pressure were placed at intervals of 5 ft., beginning one foot above the bottom of the standpipe, while at the 6-ft. and 16-ft. levels, cells for reading vertical pressures were installed.

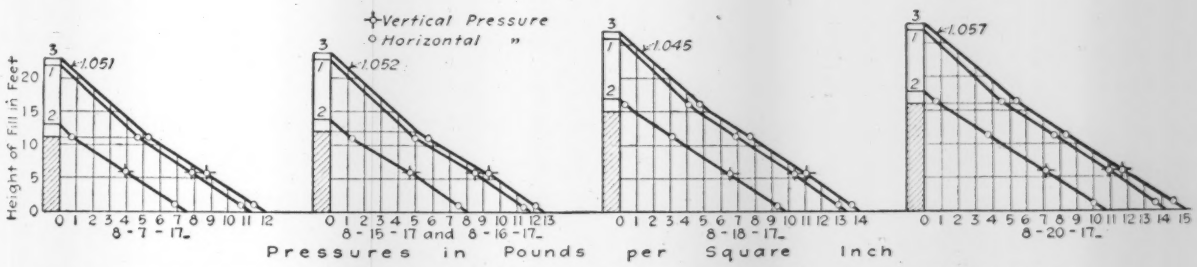
The pressure readings thus far obtained are best seen by a typical set of curves given herewith. The circles indicate lateral pressures, and the crosses vertical pressures. The curves show the level of the mud line and water level as determined from plugged holes in the standpipe spaced at one foot intervals. The pressures of the material at various heights in the pipe on Aug. 13 and Sept. 4, 1917.

The material at the bottom of the standpipe had not reached a solid state when the above samples were taken, and spurted out of the opening readily. It is to be anticipated that as more clay is deposited in the pipe and settles down the material at the bottom will become more and more compacted, the water being forced to the top. Finally a solid mass of clay will form at the bottom, and the lateral pressure exerted by it should be considerably decreased. When the clay reaches this stage, the pressure readings then taken will be of considerable value from the standpoint of the builder of hydraulic dams.

The results thus far obtained are useful in indicating what pressures to expect from hydraulic fills of this



SUGGESTION HOW TO USE CELLS FOR TESTING HYDRAULIC FILL EARTH DAMS



THESE CURVES ARE TYPICAL OF THOSE MADE IN TESTING CLAY PRESSURE IN THE TANK

Curves Nos. 1 and 2—Clay fill up to level of shaded part, with clear water above. Curve No. 3—Clay fill up to level of shaded line, with muddy water above

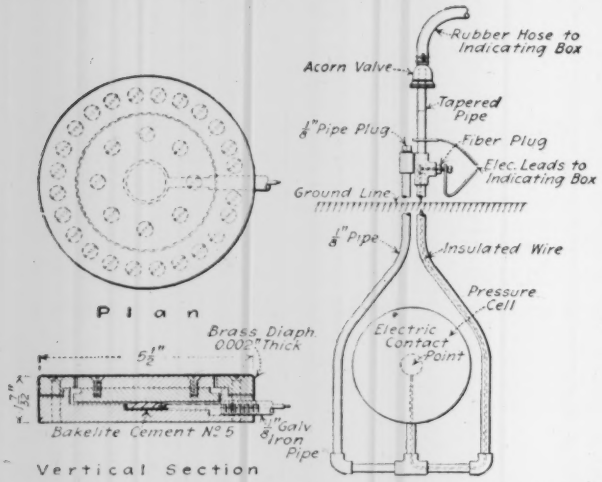
are indicated by the abscissas, and heights of fill by ordinates. Consider, for illustration, the curves of Aug. 20. The first pressure readings taken on that day are shown in Curve 1, there then being about 16 ft. of soft mud of varying specific gravity in the bottom of the tank with clear water above up to a total height of about 27 ft. After the pressure readings were taken the clear water level was reduced to a height of about 17 ft. 9 in. or a little less than 2 ft. above the mud line as shown on Curve 2. Muddy water having a specific gravity of 1.065 was then pumped in the standpipe up to a height of not quite 28 ft. and again readings were taken as shown on Curve 3. The foregoing procedure is typical of the method of filling and taking readings on the tank from day to day.

Readings and pumping have been continued in this way intermittently for a period of more than four months and the mud line has been rising with a corresponding increase of pressure readings. There is a very noticeable difference in the consistency of the mud from top to bottom, that at the top being quite liquid and that at the bottom being more viscous as determined by samples removed through openings in the side of the standpipe. The accompanying table shows the character

height, composed of material such as used in these experiments, and the results should apply to all such fills whether back of walls or dams, on top of culverts and conduits, or in tanks. Above all, the results seem to point to the reliability of the measuring apparatus for accurately measuring the pressures in such fills. In view of the fact that the cells function just as sensitively now as on the day they were buried in the fill, it would seem that they could very well be employed as a field apparatus for controlling the rate of construction and shape of cross-section of hydraulic-fill dams.

It has been pointed out that hydraulic-fill dams are subject to failure during construction due to the great lateral pressure exerted by the more or less liquid central core on the side walls. When this pressure exceeds the resistance of the side walls against sliding, failures occur such as befell the Necaxa and Calaveras dams. It would seem to the writer that the safety of any hydraulic-fill dams may be ascertained during its construction in the following manner:

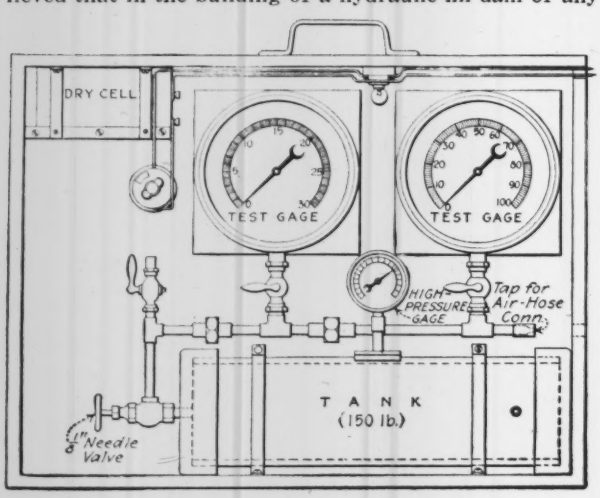
As the dam is being constructed, soil pressure indicating cells could be buried in the fill in cross-section of the dam, as in one of the drawings herewith. Let it be supposed that we wish to investigate the safety of a cer-



DIAPHRAGM CELL AND ITS ARRANGEMENT IN MAKING THE PRESSURE TESTS

tain section of the dam, *Aa Bb*. Assume that the dam has now reached a height as shown by the dotted line. The pressure acting on the core side of the section is that indicated by the curve *Bbp*. That on the outer wall side of the section by *Aao*. The difference between the areas of these two curves represents the total pressure tending to slide the particular section under investigation along the plane *A — B*. The force resisting the sliding is the force of friction acting on this plane over a width of one inch. By taking samples of the filling material laboratory tests can be made very simply to determine the coefficient of friction. The weight of samples of the material can be obtained, from which the force of friction is readily calculated. Such samples can be procured with the use of an augur from pipes placed at the proper depth in the dam during construction and lengthened as the height of the dam increases.

In the same way the safety of different sections in the cross-section of the dam may be investigated, and an analysis of such pressure readings and friction tests would indicate to the engineer how he should proceed with the filling material to prevent slippage. It is believed that in the building of a hydraulic-fill dam of any magnitude such an investigation is almost a necessity for assuring safe yet economical construction. The pressure cells after having served their purpose during construction would necessarily remain buried in the dam and would be lost. Their cost per dam, however, would probably not exceed $500, and this would be negligible when compared with the total cost of the dam, but the benefits of safety and economy to be derived from their use would warrant a much larger expenditure.



HOW THE SOIL PRESSURE APPARATUS IS MOUNTED

War Aids Scotch Ship Canal Plan

Strategic advantages made prominent by present war conditions have brought strong support to the old project for a British ship canal across the lower part of Scotland, connecting the Forth on the east with the Clyde on the west. This would afford direct communication between the North Sea and the Atlantic, avoiding the long passage around the north of Scotland. When the canal was proposed for commercial purposes there was no general support for the project, but conditions now are very different.

Two general routes are proposed: One of these is 72 miles long, with 40 miles of canal proper, the remainder of the distance being through Loch Lomond and other natural waterways. The other route is only 50 miles in length, but is in canal for nearly its entire length. Estimates of cost are $190,000,000 and $260,000,000, respectively. It is proposed to provide for a depth of 45 ft. of water and a minimum width of 150 ft. at the water level. Locks are required at the ends only. In order to provide for the largest warships these are designed to be larger even than those of the Panama Canal. They will be double, with a smaller commercial lock alongside the main lock. The latter, or warship locks, will be 1200 ft. long between inner gates, 1440 ft. between outer gates, 130 ft. wide and with 45 ft. of water on the sills, requiring gates 75 ft. high. The commercial locks will be 600 and 740 ft. long between inner and outer gates, and 80 ft. wide, with 40 ft. of water on the sills.

The present north basin will be duplicated by a new south basin connecting with the tidal or open basin. This will have four docks 3300 ft. long and 500 to 656 ft. wide, besides a pier 3600 ft. long and 800 ft. wide. The south basin will have three drydocks 650 to 1150 ft. long, capable of taking the largest steamships. Four drydocks 330 and 525 ft. in length will be built at the north basin, and all existing basins will be dredged to increase their depth about 7 ft. As a whole, the new works will add about 10 miles of dock frontage for ships. The works for this immense port were described in *Engineering News* of Sept. 19, 1912, pp. 522-524. Among extensive works planned in England are large docks or open basins without locks, at Plymouth. While these must be of a much greater depth than if locks were used, it is considered that the advantage of a port open at all times will warrant the additional expense. The City of Bristol proposes a second extension or branch of the Royal Edward dock at Avonmouth, giving nearly a mile of additional dock front, at a cost of $6,625,000.

Steel Roof Trusses Are Designed as Elastic Arches

Both Graphical and Analytical Methods Employed in Stress Analysis—Arch Without Hinge-Pins Is Adopted Mainly for Good Appearance

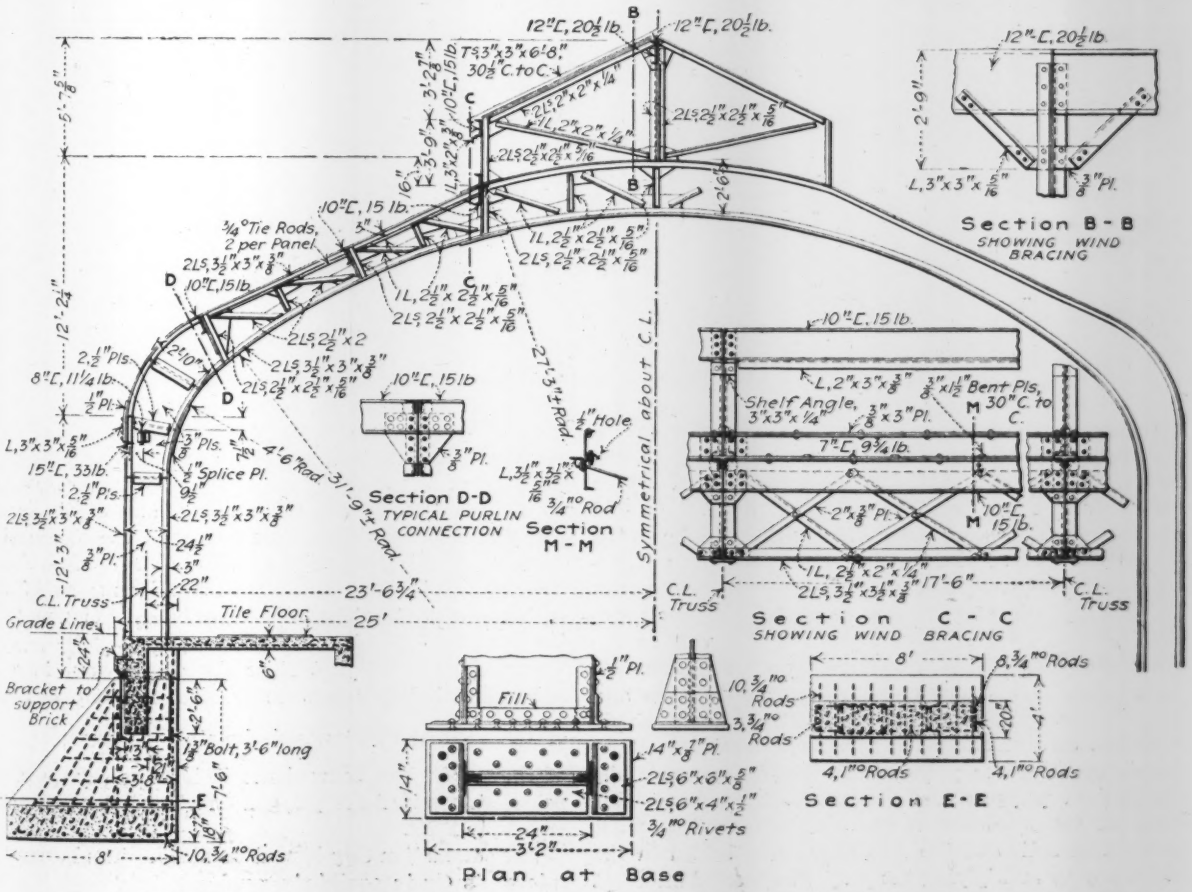
By W. Stuart Tait
Chief Engineer, Tait Engineering Co., Chicago

A STEEL arch of unusual design forms the roof of a natatorium recently erected in Moline, Ill. Since the steel members of the roof are left exposed it was desirable to provide a structural member of good lines and of lattice form. It was therefore decided to design the trusses as elastic arches without pin connections. The drawing shows the design resulting from this treatment.

It will be noticed that the foundations are placed 2 ft. 2 in. off center from the center of the columns. This was done to bring the center of the footing at the center of pressure, combining the direct load with the arch thrust. The connection between the columns and this foundation was designed to take the bending, and it will be noticed that three 1⅛-in. bolts are provided in each side of the foundation pier for this purpose. It was, of course, necessary to place these bolts on the inside only, but for practical reasons they were used on both sides. The lines of the arch desired required a relatively small depth of member at a point about midway between the center and the haunch. On account of this a very precise analysis of the stresses was required, and it was therefore decided to use the method of design worked up by A. C. Janni, C. E., and presented to the Western Society of Engineers in January, 1913. This method is a graphical analysis and the various graphs are shown in the drawing. In addition to making this graphical solution, the results were checked by the analytical solution given in "Modern Framed Structures" by Johnson, Bryan and Turneaure.

Since this method of design is not one in general use the various steps and graphs will be explained.

The first step is, of course, to estimate the dead loads, and calculate the live and wind loads at the various intersections of the lattice members. On account of the fact that lattice members between points 4 and 8 were very nearly parallel two bays only were considered in the first graphical analysis between these points and calculations were later made to provide for the introduction of four bays between points 4 and 8.



STEEL ARCH ROOF TRUSS FOR NATATORIUM IS CONTINUOUS ELASTIC STRUCTURE TO BASE OF FOOTINGS

In the next step the elastic function—termed the elastic weight by Janni—for each of the chord members was calculated. On the authority of W. Ritter, these elastic functions were considered as acting about the point of intersection of the two lattice members connecting the member under consideration. In the case of member 4-6, for example, its elastic function was taken about point 5. Thus, as the area of the member (2Ls 3 x 3½ x ⅜ in.) is 4.6 sq.in. and its length is 90 in., neglecting the moment of inertia about its own axis the moment of inertia of the member 4-6 becomes, where y is the perpendicular distance between 4-6 and 5, $I = ay^2 = 4.6 \times 18^2 = 1490$ and the elastic function, G is equal to length/I = 90/1490 = 0.06.

In the next step the horizontal and vertical components of the elastic functions of the members are found. Refer first to the force polygon "Fa." The elastic function of member 0-2 about point 1 is laid off horizontally as length designated 1, similarly the elastic function of member 1-3 about point 2 is represented by length 2, and so on. The pole distance a is made equal to one fifth the sum of the elastic functions; that is, $\frac{1}{5}\Sigma G$. The reason for this will be apparent later. Note that a is one-fifth of the summation of the elastic functions of both sides of the arch and that in force polygon "Fa" the functions for one side only have been plotted. The rays as illustrated are then drawn in the force polygon "Fa," and from this the equilibrium polygon "fa" is constructed. From this diagram the moments of the elastic functions about the line of action of the resultant are obtained in the usual way by multiplying the proper horizontal intercept by the pole distance a.

The elastic weights are now treated in a similar manner considering them acting vertically, and force polygon "Fb" and equilibrium polygon "fb" are drawn. The vertical ordinates taken from "fb" multiplied by pole distance b give the moments of the elastic functions about the vertical axis of the arch.

In the next step the summation of the moments of inertia of the elastic functions about the vertical and horizontal axes are obtained.

In force polygon "Fc" the vertical intercepts represent the quantities Gx, G being the elastic functions and x their respective distances from the vertical axis.

THESE STEEL ROOF TRUSSES ARE DESIGNED AS ELASTIC ARCHES, NO HINGE-PIN CONNECTIONS BEING USED

These quantities Gx are treated as forces and the force polygon "Fc" is drawn with any convenient pole distance c. From this equilibrium polygon "fc" is constructed. The vertical intercepts in this polygon multiplied by c equal the moment of inertia of the respective elastic functions about the vertical axis of the arch. The distance d will therefore represent the summation of the moments of inertia of all the elastic functions; that is, ΣGx^2. In a similar manner by means of the force polygon "Fd" and the equilibrium polygon "fd" the quantity ΣGy^2 is obtained.

It will be noted that since the elastic functions in a horizontal direction were treated for only one-half of the arch, the distance designated $\frac{e}{2}$ represents half of the ΣGy^2. For convenience in later calculations the pole distance in force polygon "Fd" is taken the same length as ΣGx^2.

The summation Gxy is next obtained. The horizontal intercepts Gy in equilibrium polygon "Fa" used before to obtain ΣGy^2 are now plotted vertically in force polygon

"Fe". The pole distance e in this polygon is made equal to ΣGy. Equilibrium polygon "fe" is now drawn and the vertical ordinates multiplied by e will represent the quantities Gxy. From these diagrams the quantities occurring in the fundamental equations for the reactions of the arch are obtained. In Vol. 3 of Hool, these equations are derived and given as follows:

$$M_a \Sigma G = P \Sigma_p^B Gx' \qquad (1)$$

where x' is the distance from the elastic function to the loaded point and the summation $\Sigma Gx'$ is made between the loaded point p and the right-hand support B.

$$V \Sigma Gx^2 = P \Sigma_p^B Gxx' \qquad (2)$$

$$H \Sigma Gy^2 = P \Sigma_p^B Gx'y \qquad (3)$$

Now $\Sigma G = b$ in force polygon "Fb",

$\Sigma Gx^2 = d$ in equilibrium polygon "fc"

and $\Sigma Gy^2 = e$ in equilibrium polygon "fd"

Also $\Sigma Gx'$ is obtained from equilibrium polygon "fb"

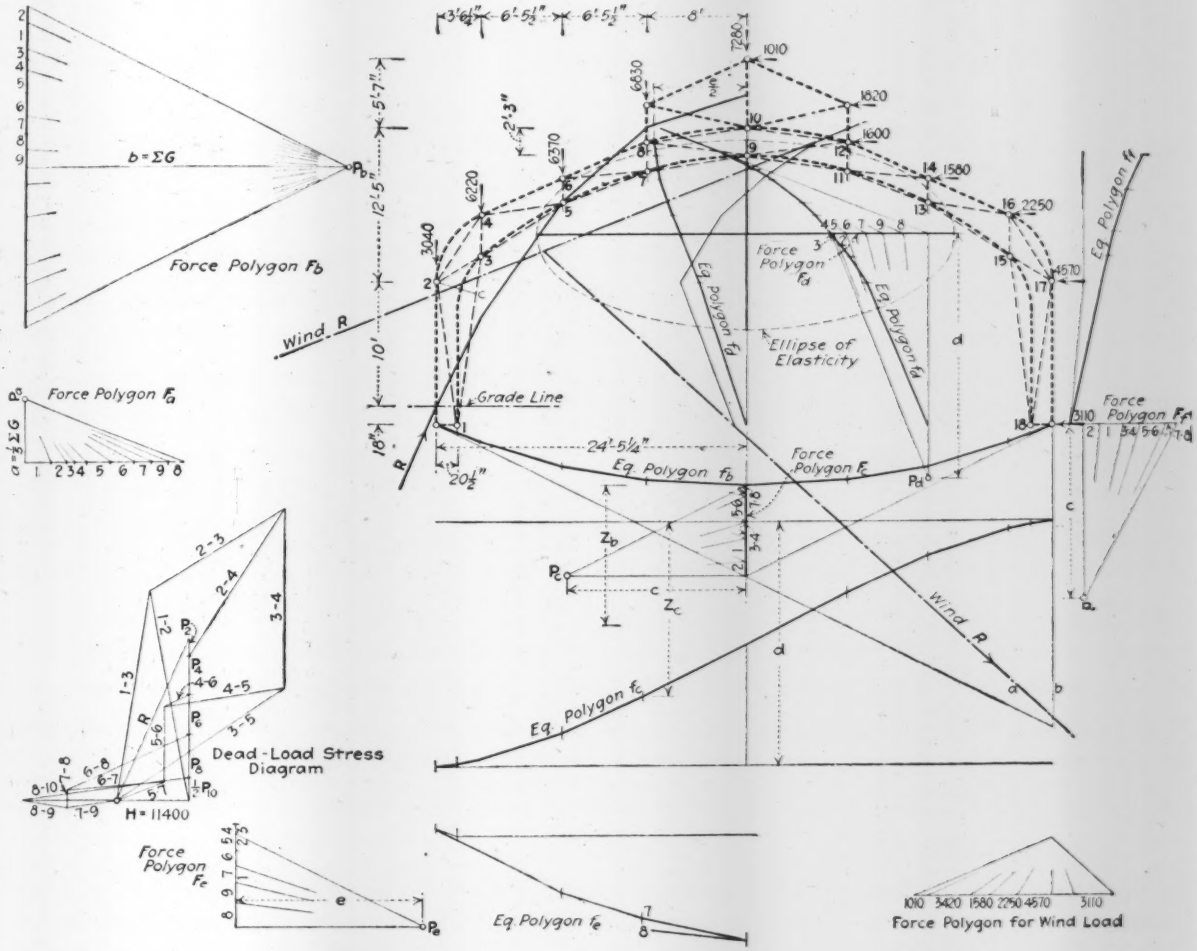
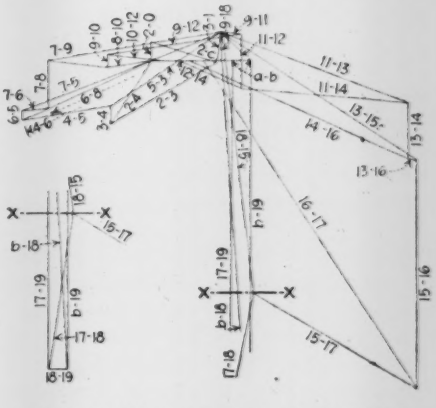


TABLE OF STRESSES

MEMBER	D-L	S-L	W.L.	MAX.	MIN.
0-2	-26100	-13050	+4800	-88500	-21300
1-2	+34500	+17250			
2-4	+28000	+14000	+12000	+42000	-34800
4-6	- 4200	- 2100	+22600	-32600	+18400
6-8	-21200	-10600	+18000	-32200	- 3200
8-10	- 7400	- 3700	+ 7200	-11100	+ 800
10-12	- 7400	- 3700	+ 8200		
12-14	-21200	-10600	-11000		
14-16	- 4200	- 2100	-38400		
16-17	+28000	+14000	-62800		
17-19	-26100	-13050	-62400		
1-3	-34000	-17000	- 5000	-51000	+ 8200
3-5	-32000	-16000	-21200	-53200	+ 4000
5-7	- 8000	- 4000	-34000	-42000	+24000
7-9	+ 8000	+ 4000	-27900	-19900	+12000
9-11	+ 8000	+ 4000	+ 3200		
11-13	- 8000	- 4000	+32000		
13-15	-32000	-16000	+36000		
15-18	-34000	-17000	+42200		
3-4			- 2800		
5-6			- 1400		
7-8			- 7800		
11-12			+ 8600		
13-14			+ 9000		
15-16			+36400		
17-18	+34500	+17250			
9-10			- 2200		



GRAPHICAL ANALYSIS OF ELASTIC ARCH TRUSSES BY METHOD OF ELLIPSE OF ELASTICITY

in the usual manner. Thus, for example, for a load P at the point 8, $\Sigma Gx' =$ ordinate zb multiplied by pole distance a, also $\Sigma Gxx'$ is obtained from equilibrium polygon "fc," and $\Sigma Gyx'$ is obtained from equilibrium polygon "fe". Substituting the values in equations (1), (2) and (3), the moment Ma, which is the moment of any load about the center of the ellipse of elasticity, and the corresponding vertical and horizontal components of the reactions of this load are obtained. Combining these values V and H, the direction and magnitude of the resultant reaction are obtained. By dividing Ma by the magnitude of the resultant the eccentricity of the reaction is obtained.

Equations (1), (2) and (3) are solved for each load occurring in the arch, and Ma, V and H are summarized. The reaction R is thus obtained. Having H, which in this case is 11,400 lb., V and R, a stress diagram can be drawn from which the stresses in the various members are obtained for the vertical loads.

Taking the wind loads, the same diagrams will be used except equilibrium polygon "fe" for $\Sigma Gyx'$. This polygon was constructed for vertical load and horizontal ordinates x'. For the horizontal loads the force polygon "Ff" and the equilibrium polygon "ff" are constructed; the former is simply the force polygon "Fc" rotated 90°. The ordinates in the equilibrium polygon "ff" multiplied by the pole distance c represent $\Sigma Gxy'$, where y' is the distance from the elastic function to the load under consideration.

The quantities Ma, H, V and R for the wind loads are then obtained in the same manner as the similar quantities for the vertical loads and the stress diagram for wind stresses in the members obtained.

From these two stress diagrams a table of maximum stresses is prepared and the members are designed in the usual way.

On account of the unusual nature of the design it was deemed advisable to analyze the structure by two entirely different methods. The values Ma, H and V were consequently obtained by the method outlined in Johnson, Bryan and Turneaure. In making this analysis the value $\frac{ds}{I}$, which in the method given is made constant, was taken as variable to correspond with the graphical solution.

Arch ribs of I-section are used, with a pair of angles for each flange or chord. Single angles form the web members in the latticed portion, while a plate web on each side extends from the footing to the haunch. The arches have a span of 47 ft. 1½ in. between centers. They are spaced 17 ft. 6 in. apart, and carry steel channel purlins, with T-iron rafters on which rest gypsum roof slabs. These rafters appear in the view, but in the finished structure they are covered by a plaster coat. Framing for the monitor roof is carried by the arches. For longitudinal wind bracing there are two lines of lattice trusses in the plane of the sides of the monitor. The design provides for a snow load of 20 lb. and a horizontal wind pressure of 20 pounds per square foot.

O. A. Eckerman, of Moline, Ill., was the architect. The structural design was prepared under the direction of the writer.

Frost No Respecter of Meter Setting

FEW kinds of water-meter setting seemed to be proof against frost last winter in Terre Haute, Ind. The soil is sand and gravel into which the frost penetrated to a depth of 4½ ft. The water company had only 7064 metered services, but of this number 8.7% were frozen. The percentages affected of the different types are as follows, according to Dow R. Gwinn, president of the Terre Haute Water Co., discussing the subject at a recent meeting of the Indiana Sanitary and Water-Supply Association: 4.5% of 66 meters set in 18-in. tile boxes 4½ ft. deep; 2.6% of 2000 meters set in basements; 16.2% of meters set in brick pits 3½ ft. deep; 11.2% of 3959 meters set in 15-in. tile boxes 4½ ft. deep. None of the 317 meters set in brick pits 5 ft. deep was affected.

The character of the soil and the degree of compactness of the soil around the boxes are factors which affect the depth to which frost will penetrate. Meters newly set where the soil is not solidified by a season's rains are more likely to freeze than meters which have been in service a longer period. From the discussion it was brought out that frost penetrates loose sandy soils to a much greater depth than clays, varying from 2 to 5 ft. in the same locality. If the bottom of the pit is below the frost line, protection is assured in most cases. Such expedients as boring a hole with a post-hole auger and dropping in two or three lengths of tile pipe have proved effective in keeping the whole pit warm by the radiation of heat from the earth. This of course is contingent upon a tight pit, and in some cases on not opening the pits for reading meters on coldest days.

Freezing and protection of meters and hydrants was discussed also by H. M. Ely, superintendent of the Interstate Water Co., Danville, Ill. Basements if well heated and well protected are the best locations for meters. Next in order are wells at the curb line, of which Danville has many made of 15 x 18-in. vitrified sewer pipe. Meters set in this manner at a depth of from 28 to 33 in. below the surface, with a close-fitting cast-iron rim and cover, and a second inside cover set directly above the meter, were proof against the severe freezing last winter. Meter wells are made of two sections of 2-ft. sewer pipe. Some are now made of concrete in various lengths.

The inside cover is 1½ in. thick and is in two pieces, having a 2 x 4-in. hole cut in the middle of each piece and both pieces held together by leather hinges. These covers are made about ½ in. smaller than the inside diameter of the pipe, and are held firmly in place by wedges driven between lid and tile, after which the joint around the outside is calked with jute. The 4 x 4-in. hole in the middle is completely covered by a block of wood. If upper and lower lids are carefully put back after being opened for any purpose, the danger from freezing is slight. When meters are frozen they are taken out and fillers put in place. They are repaired if possible and are reset promptly.

Out of 1945 meters, 94, or 4.8%, were frozen, 13 of these being in wells and others in basements. The 13 meters froze after the wells had been opened and closed again, thus breaking the air seal. The two lids were

not carefully replaced and re-covered with snow. In extreme cold spells the reading of small meters in wells not equipped with an inner lid is omitted, being left until the next reading period. The frost penetrated last winter to a depth of 1½ ft. in dirt streets and gutters and to 4½ ft. under brick and concrete pavements.

Imperfect Back Filling Cause of Much Damaged Pavement

Plumbers More at Fault Than Corporations Who Take Every Precaution—Competent Inspectors Are Expensive but Needed

By George S. Nobles
Formerly Assistant Engineer, Bureau of Highways, Brooklyn, N. Y.

Owing to the abnormal severity of the past winter damage to city pavements promises to be very great this spring because of the large number of openings made necessary for thawing out water services and because of the excessive number of leaks in mains and services that have already been experienced or which will become apparent with the approach of warmer weather. Leakage in mains developing under the pavement cavities over which the concrete sooner or later breaks down is usually soon noticed by virtue of the large volume of water involved. With house services it may continue for months and be detected only when the diminishing supply for household purposes or depression of the street service gives warning. A sudden cave-in is at times the first indication of danger, and occasionally the whole street, from curb to curb, and for a distance of fifty feet or more is undermined and perhaps destroyed, involving a serious loss.

Main breaks are caused by excessive pressure, flaws in material or settlement, allowing joints to open, while house services fail through electrolytic action, defective plumbing, sagging under the weight of superimposed earth or freezing. Though slower in action and less spectacular, destruction due to the latter sometimes very considerable proportions and sinkage of from 5 to 15 sq.yd. of pavement is not exceptional.

Precisely analogous to the preceeding are breaks in main sewers and house sewer lines. The former frequently contribute to the seriousness of a water service leak by affording a line of flow and place of deposit for the earth carried away, and examination of the main sewer is consequently one of the first steps in the investigation of sinkage. Connections were formerly made from the house to the existing short branch built into the main sewer at an angle of about forty-five degrees by bending each joint a little to get the necessary curve. These joints were often defective, allowing the waste to discharge into the bed of the street, with resulting settlement.

"Cut-ins" where no branch existed were formerly not so stringently prohibited. In this operation the wall of the sewer is broken in to obtain an inlet. In modern practice spur connections running to the curb line for future continuation to the new building are laid for every lot at the time the main sewer is built, which obviates pavement disturbance and insures a good house line, as a perfect one-eighth bend takes the place of slightly open joints at the curve. An interesting case arose some time ago where a plumber had installed four house leaders to take off rain water and had failed, by about three feet, to connect the house lines under the street with the sewer. A few months of wet weather resulted in very bad sinkage.

Damage to pavements from the causes cited is practically unavoidable. There is, however, room for the exercise of considerable care in the matter of backfill at the time of original construction or when repairs have been made, and this will be well worth the effort expended in the prevention of further destruction. Poor backfilling presents a serious problem to the engineer, whose appropriations for pavement maintenance are naturally limited under present economic conditions. It is noticeable that the damage caused by plumbers is distinctly greater than that by corporations. The work of the plumber is not subject to supervision, and it is nothing unusual to find from a half to a cubic yard of earth left on the pavement after backfilling is supposedly completed.

In making surface installations of any length, "tunneling" is largely resorted to except where expressly prohibited. In this operation the pavement is not cut for the whole distance, but openings are located convenient to the job in hand, and a horizontal boring is made in the intervening earth under the undisturbed surface, through which the pipe is pushed. Unless performed with care, this proceeding is likely to make a hole larger than is actually needed and voids are left along the line. As might be anticipated, plumbers—many of whom employ a low class of labor and who are on the work in person only at intervals—are the worst offenders. Placed under the direction of competent foremen, corporations achieve better results, and experience supports this statement with little variation. Of course settlement and subsequent destruction of pavement always results from carelessness in backfilling.

On big work, such as open cut trunk sewer and subway construction, a temporary surface—such as granite block on sand—is allowed to remain for a sufficient time to secure good compaction of the fill. This is extremely common, but for minor sub-surface work only competent supervision is satisfactory. This is a financial problem and rests upon the availability of experienced inspectors. A plan to cut down costs in this respect has been tried with good results, and depends upon the assignment of especially capable laborers to supervise the replacement of the earth. The saving is due to the fact that the daily wage of a laborer is normally only about half that usually paid to inspectors for such work.

Two other points are worth considering in connection with the subject. Many engineers have deemed it proper to allow the old sheeting along the line of trunk sewer excavation to remain in the ground when filling in. Certainly where this is done it should be cut off well below the level of sub-surface pipes. It is not uncommon to find a lead service ripped apart by settling and catching on the edge of buried sheeting, and where these conditions are known to exist numerous plumbers now take the precaution of encasing their lead pipe in an iron one for protection.

Fort Madison Water-Works Rehabilitated by Citizens' Corporation

Pumping Plant Rebuilt, Purification Provided, New Intake, Duplicate Force and Reinforcing Mains Laid—Distribution System Extended and Universal Metering Begun Without Interrupting Service

By R. E. McDonnell
Burns & McDonnell, Consulting Engineers, Kansas City, Mo.

THE building of a new water-works pumping station on the exact site of an old one and the removal of every vestige of the old plant without interruption of service was one of the features of the recent improvement and extension of the water-works of Fort Madison, Iowa. At the same time a filtration plant and a reservoir were built, mains extended, and the installation of a universal meter system begun.

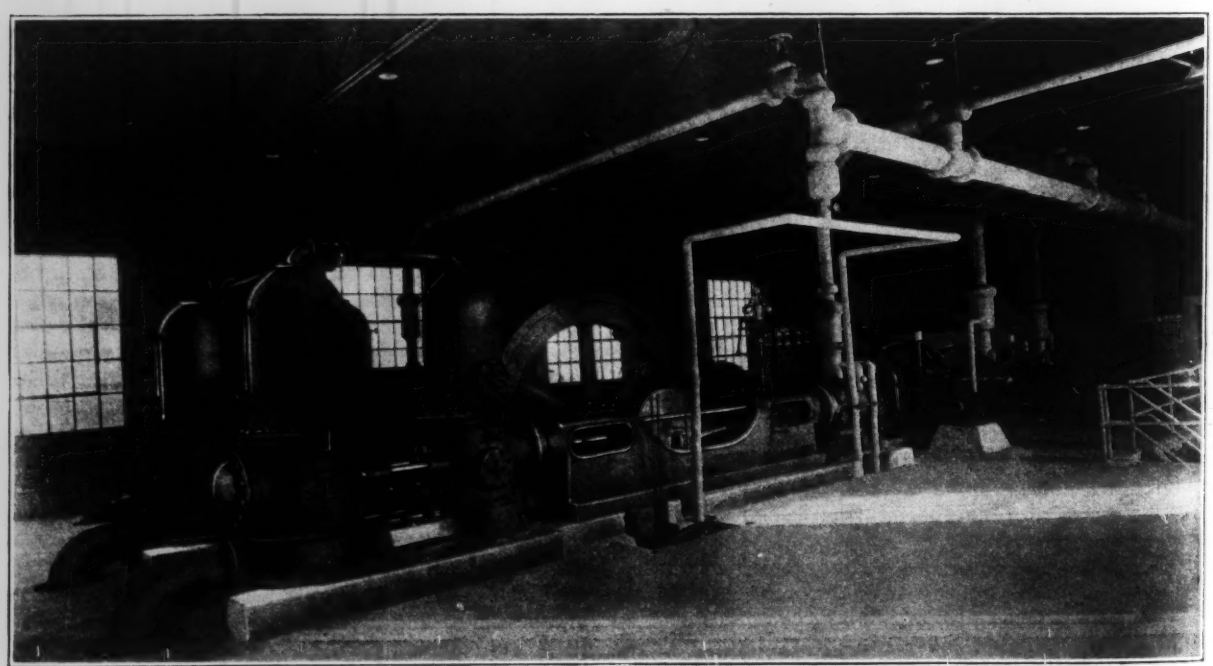
Because of the quality of the water and insufficiency of the fire pressure [supplied by an old water company —Editor] it became incumbent upon the city to provide more satisfactory water and a better fire service. The ciay was without bond power to provide for a municipal plant, consequently 25 of the leading citizens organized the Citizens' Corporation, which was granted a franchise, took over the old proeprty, and began the reconstruction of the entire water-works plant, involving an expenditure of about $300,000. The experience with the plant was a lesson which caused the new corporation to exert every effort to avoid the errors of the past and to turn an unprofitable into a profitable business.

Practically the only parts of the old works found to be usable were one of the two pumps and the distribution system. This pump was retained for emergency use temporarily. The force main was duplicated and the distribution system was reinforced in the business district and extended about seven miles, chiefly in residence districts. The old intake was abandoned because the Keokuk dam raised the level of the Mississippi about 15 ft. at Fort Madison, and it was considered advisable to provide an intake considerably above the main bed to avoid burying by sediment.

The first work started and completed was a 1,000,000-gal. reinforced-concrete storage reservoir, thus affording some storage of water in case of interruptions in operation of the pumping equipment.

One old boiler was disconnected and displaced. Foundations were built and a new boiler was then erected and put in commission. Then the second old boiler was replaced.

A temporary smokestack was built from old corrugated-iron culverts and supported above the boilers by a frame of structural steel taken from the old building, and above that by guy wires placed at such a height as not to interfere with the placing of roof trusses and other building operations. A complete new stack was erected and as soon as the new boilers were placed the new breeching was set and connected to the new stack. During the time these changes were being made the building was also being constructed and firemen, engi-



A NEW 3,000,000-GAL. CORLISS PUMPING ENGINE IS THE MAIN RELIANCE FOR HIGH SERVICE

neers and operators had to be protected by canvas covers stretched over framework built above the boilers and pumps. In spite of the severe winter weather this work was carried on without interruption.

In making the excavation for the new pumping-station it was necessary to take up the old discharge pipes from the pumps and replace them with temporary connections.

New Pumping Plant

In the pump room a concrete foundation was built for the new 3,000,000-gal. high-service Corliss pumping engine and a 3,000,000-gal. duplex reserve pump. Just as the new pump was ready to be placed in service one of the two old ones suddenly gave out—after 32 years of existence and after two jobs of welding. Steam was turned into the new pump immediately after the collapse of the old one and continuous service was maintained with scarcely an interruption, except for a few minutes for adjustments to the new pump. The old pump was broken up by dynamite. The remaining old duplex pump, which has a rated capacity of 3,000,000-gal. a day, is held in reserve.

The addition of purification works made necessary the provision of low-lift pumps to deliver more water to the new concrete-lined settling basins. There are two of these pumps, each motor-driven, with a daily capacity of 3,000,000 gal. Duplicate generating units supply electric current to these pumps, to the blower and wash-water pump for the filter plant, and to the lighting system.

All the coal at the new pumping station is weighed. Automatic weighing and recording devices show the amount of water evaporated per pound of coal used.

All the water is metered in passing from the low-service pumps to the filtration system. This is essential because centrifugal pumps constantly pumping water containing sediment lose their efficiency and a constant check was desired in order to determine when and how often new impellers should be placed in the low-service pumps. As a further check on the wastage of water, all water is metered in passing from the high-service pump to the storage reservoir and into the mains. A universal water system is being adopted along the 21 miles of cast-iron distributing mains, in the belief that the only businesslike way of selling water or any other commodity is by absolute measurement of the volume.

The Purification Plant

The purification plant includes reinforced-concrete settling basins and a large mixing chamber into which the pulverized sulphate of aluminum used as a coagulant is fed by dry-feed machines, and four 750,000-gal. mechanical filter units arranged in a single row. Carload capacity storage for chemicals is provided on the third floor of the filter house.

As the concrete settling basin was built on a sedimentary deposit it was placed on a large reinforced-concrete slab, the reinforcing consisting of 75 tons of old steel rails. The basin has been in place about a year, and measurements show less than ⅛ in. of settlement.

A duplicate force main was laid to the business district and reinforcing mains were also laid in that part of the city. The distribution system was extended seven miles. By the use of existing gate valves, connections between the old and the new mains were made with but slight interference to the supply in residential districts.

The construction of the distribution system, as handled by Stephen Schulte, Fort Madison, shows that it is possible to put new water mains in service and begin to earn rates about as fast as each block of extensions is completed. This was accomplished by the plentiful use of gate-valves and the prompt working of house-connections before the trenches were refilled.

Tests show that the filtered and chlorinated water (liquid chroline treatment) is of high bacterial quality. This, with the satisfactory physical quality of the water, the improved character of the service generally, and the extension of the mains, has resulted in a rapid increase of water consumption since the new plant went into operation about six months ago.

The general construction, being of a complicated nature involving unforeseen conditions, was handled on a cost-plus percentage basis by the Wodrich Construction Co., Minneapolis, which plan work proved satisfactory. The pumping machinery and steam-power plant equipment were furnished and erected by the Merkle Machinery Co., of Kansas City, Mo., and much of the erection was handled on a cost-plus basis.

The entire engineering work was performed by Burns & McDonnell, consulting engineers, Kansas City, Mo., and their supervising engineer, C. E. Painter, has remained in charge of the operation of the plant.

The financing and management of the entire project was accomplished by local capital under the direction of T. T. Hitch, president of the Citizens' Corporation, and Peter Kern, secretary.

Hundreds of water plants throughout the country could profitably carry out similar reconstruction, but unfortunately many owners and operators of water plants, both private and municipal, lack the nerve to scrap an old plant when it becomes obsolete.

Extensive Irrigation by Pumping

Three irrigation projects requiring an estimated expenditure of more than $500,000 to irrigate 40,000 acres, each project including diversion of water from the Sacramento River by means of pumping plants, were submitted to the California State Water Commission not long ago. All the lands to be irrigated are in Sutter County. Of two applications made by the Sutter Basin Co., Sacramento, the first calls for a diversion of 120 sec.-ft. by means of two 30-in. centrifugal pumps operated by 100-hp. motors, the normal head in this case to be 8 ft. This plant would irrigate 9337 acres at a cost of about $152,000. A second project by the same company involves a 24-in. centrifugal pump driven by a 75-hp. motor, the pump to work under a normal head of 16 ft. This project includes 2020 acres and the cost of carrying it out is estimated at about $20,000. The third application was filed by the Chicago-California Development Co., Sacramento, which proposes to divert 410 sec.-ft. for the irrigation of 32,545 acres by means of three 48-in. pumps, working under a normal head of 6½ ft., driven by 175-hp. motors. The estimated cost of this project is $530,000.

Iowa County Builds Brick Road From Camp Dodge to Des Moines

Rapid Paving of Highway for Military Traffic—Heavy Side-Form for Concrete Base—Earth Cover Protects Grout from Frost—Labor Changes Continually—Engineering by State Commission

IN IMPROVING four miles of the Merle Hay Road, which forms the main connection between Camp Dodge and the city limits of Des Moines, Iowa, monolithic-brick paving had its first tryout on the country highway system of Iowa. Only half of the highway is completed—the work having been shut down by the closing in of winter—and while no remarkable variations from monolithic-brick paving practice were introduced, several of the details and some of the circumstances connected with the work are novel and worthy of mention. The road at the time construction was started was unimproved in any manner, and because it was but little used the farmers had encroached on it from either side, in some cases as much as 25 ft. As a result a good deal of fencing had to be moved back to make possible the construction of a 20-ft. paved section flanked at either side with 6-ft. gravel shoulders, which were extended by 2-ft. earth shoulders before the drainage ditch proper began. The details of the adopted cross-section are shown on the accompanying line drawings.

While the maximum gradient does not exceed 5%, the grading amounts to 47,000 cu.yd. and includes some 14-ft. cuts and a few 6-ft. fills. On this work graders and dump wagons were employed. In spite of the necessity for speed, all fills were rolled in 6-in. layers compacted with a 16-ton gasoline tractor for the most part. While a 10-ton roller had been specified, the tractor which was on the ground was found more serviceable on account of its large and wide wheelbase and its greater ability to work in wet spots and difficult places without danger of upsetting.

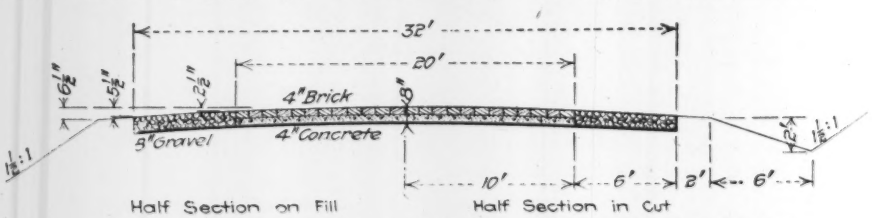
After the surface of the roadbed had been prepared for the concrete base by teams and scrapers, the subgrade was dressed by a 2-in. plank template which was drawn ahead of the concreting. This template was allowed to rest on the side forms and was adjusted so as to allow for a ½-in. compaction under the working of the rollers. While the specifications called for a one-inch compaction, this was found more than could conveniently be accomplished by the rollers. In some place a template, after the design by Alan Parrish, was used for this work, although brought to the job for the purpose of smoothing off the concrete base before laying brick.

Side-forms were made of 4 x 8-in. timber in 16-ft. lengths—each length being being held by three 2 x 4-in. stakes. This length was held to except on curves, where shorter lengths were necessarily employed. Contractors at first objected to the size of timbers specified for side-forms, but they soon recognized their value after finding that their weight and length—the reason for the objections—enabled them to stand up with great success against the attacks of wagons, motor trucks and even the steam rollers. The concrete was deposited between these forms to a thickness of 4 in. and was shaped to a crown of 2½ inches.

Washed pit-run gravel was used for the concrete, the mix averaging one sack of cement to 5½ cu.ft. of gravel. This resulted in a proportion of approximately 1:2:4. The specifications called for a minimum period of mixing of 1 min., during which time the drum must have revolved at least 12 times. Every effort was made to keep the consistency uniform, the exact amount of water desired being such as would produce a batch which when piled up would gradually squeeze out at the bottom. The necessity for a uniform mix showed up occasionally when the brick were laid on a spot where the concrete was a little wetter than usual. Such spots would always produce a low area in the resulting surface. Occasionally, where two or more batches of a too fluid consistency had been deposited, it was found necessary to tear up the brick for a space of 6 to 8 ft. in diameter and make an addition of dry consistency concrete to bring the spot up to the proper elevation. The most damaging place for a too wet consistency was found to be near the edge of the pavement, where the brick carriers had to walk over the surface of the green concrete in bringing "pavers" to the layers.

While the specifications demanded that the concrete templates be advanced by drum and cable in order to avoid jerks, an attempt was made to drag the template by attaching it to the mixer in such a manner that the traction tackle could be paid out by men holding the free end. This proved entirely satisfactory and was allowed on the rest of the work. Some trouble was experienced at first from the concrete being roughened by the template pulling out some of the larger stones, but this was eliminated by careful grading of the aggregate, proper tamping and the occasional use of a rake in front of the template. Wherever the surface was roughened in this way a man smoothed the rough spots with a long-handled wooden float.

While the monolithic type of pavement calls for immediate grouting, the necessity for speed on this particular job was such that the bricklaying was continued until



ROADWAY HAD 6-FT. GRAVEL SHOULDER, WHICH WAS HARROWED THOROUGHLY TO SECURE UNIFORMITY

dark and sometimes had proceeded to a point 200 ft. in advance of the grouting. In every case, however, rolling was completed before work was discontinued. Inspection was left until the morning, when on account of the low temperature at which the work was being carried out it was found possible to cull the brick, fill low spots and reduce abnormally high points without

ONE OF THESE MEN LAID ALL BRICK ON 500 LINEAR FEET OF ROADWAY IN ONE DAY

affecting the quality of the work. On the average, culling resulted in removing 1 to 2% of the brick, although in some few instances "throwouts" ran as high as 14 per cent.

Progress in bricklaying was extremely slow at first, which caused considerable worry among the military officers, who demanded that additional bricklayers be employed. Although before the force was well organized sometimes as little as 40 ft. of paving was laid in a day, the engineers reassured the military authorities that the work would be completed in the expected time and in fact ultimately attained a daily average of 400 lin.ft. The maximum daily record for one man was 500 ft. of 20-ft. paving. Since the brick ran 39 per square yard, this meant the handling of 43,300 brick; or, since the brick weighed 9.75 lb. each, a total of 211 tons. The bricksetter who made this record laid during a short period an average of two brick per second.

After rolling the brick with a sand-filled roller weighing 700 lb., the surface was in general well within that degree of smoothness called for by the specifications. A variation in the elevation of the brick of $\frac{1}{16}$ of an inch was permissible, and when evenness within this limit could not be obtained by the ordinary process of rolling, hand tamping was resorted to.

The initial grouting with the 1:1 mix was kept thin and watery and was spread with rattan brooms and wire brushes, as is usual in such cases. The second or thicker grout followed at the expiration of about one hour and was worked so as to leave a thin skin on the surface of the brick.

To prevent damage by frost, a 2-in. earth cover was applied after grouting on days that seemed to demand this expedient. This covering was shoveled on from the sides of the road, and in some cases was allowed to wear off under traffic, although the majority of it was removed by hand or road graders. Where the covering was applied soon after the application of grout, the resulting surface seemed slightly rougher, although in no way inferior in quality.

Concreting not having commenced until Oct. 18, a good deal of the work was laid under rather adverse conditions as far as atmospheric temperature was concerned. The cold weather, while a hindrance in many ways, proved an advantage in other directions in that the slower setting of the concrete allowed the bricklaying and other operations to be separated more widely than was contemplated by the specifications. The scattering of the several working forces and the resultant freedom from interference produced greater efficiency than is ordinarily the case with monolithic construction.

The gravel shoulders were built up in two layers, each being harrowed and rolled. Special care was taken to produce as homogeneous a grading of the various sized particles as possible, and for this reason a spring-tooth harrow was employed. Though not shown in the illustrations, drains of coarse stone are laid under each shoulder.

When work was stopped for the winter on Dec. 3 all grading had been finished and paving had been completed for 2.3 miles. This was in spite of serious labor troubles which resulted in the work being carried on each day with a practically new gang. Other difficulties were experienced in getting teams and trucks, and because the average haul for materials was 1½ miles, strenuous efforts were necessary to maintain a steady flow. Three 1-ton trucks were used to haul the gravel, the brick being transported by a trailer truck which handled 1200 per load. The contract for the entire work

GROUT WAS MACHINE MIXED—ROLLER WEIGHED 23 POUNDS PER LINEAR INCH

was let to Aitken & Flutter on Sept. 15. Grading was started on Sept. 25, employing two outfits of 80 horses and mules. Concreting commenced on Oct. 18.

All construction costs are being paid by Polk County, although the state highway commission pays the engineering costs with the exception of living and transportation expenses of the engineers. Plans and con-

tracts were approved by the state commission as in all work of this character. The work is under the immediate direction of Thomas H. MacDonald, chief engineer, and F. H. Mann, assistant engineer, who designed the road, prepared plans and assisted and advised the county board of supervisors as to letting of the contracts. All bills are approved by the state highway commission or its engineers, and are immediately passed for payment to the board of supervisors of the county.

Sixty Steam Heating Stations Serve Camp Funston

Barracks Have 18 Central Plants with 5-Inch Overhead Outdoor Mains—Officers' Quarters Have 42 Separate Installations

STEAM heat is used mainly at four of the large army camps: Camp Funston, in Kansas; Camp Custer, in Michigan; Camp Grant, in Illinois and Camp Devens, in Massachusetts. These plants were installed under the same general plan, prepared at Washington, while detail drawings and alterations were made by local engineers to suit local conditions. The following description of the installation at Camp Funston will apply in the main to other camps. It is taken from a paper read before the Kansas City chapter of the American Society of Heating and Ventilating Engineers by B. Natkin, Kansas City, Mo.

Camp Funston has a site about 1 x 1½ miles, on which are erected 1400 wood buildings. Of this number 650 buildings are heated from 18 central steam plants, each taking care of about 35 buildings. Steam is distributed from them by overhead mains supported on poles. The main line pressure is 50 lb., reduced at each building to about 5 lb. by a reducing valve. The poles are 20 ft. apart and the steam main is suspended about 15 ft. in the air from trapeze hangers. The average size of main is 5-in., and the average run is 1200 ft. The drop in pressure at the end of the main is about 20 lb. Expansion is taken care of by slip joints at 200-ft. intervals. Branches to the various buildings are taken off at the bottom of the mains, the lines thus being drained approximately every 75 ft. The mains are covered with 1-in. of asbestos air-cell covering, then 1½ in. of wool felt, over which is waterproof roofing paper securely wired.

Overhead lines without return were first used in preference to underground with return because they were cheaper to install, could be readily got at for repairs, and material could be obtained more readily. A limited water-supply with a large percentage of scale has made it necessary to install a return-line system to save the condensation. The lines run to a central low point in each unit, where the water is collected by an electric pump and receiver, which in turn discharges it to the boilers. It is probable that had the Government engineers foreseen this necessity of underground return lines, they might have put the steam lines also under ground, as it would have proved less expensive than the present system of overhead lines and underground returns.

Each boiler house has four 6 x 18-ft. tubular boilers of 150 hp. each, having individual 34-in. steel stacks 60 ft. high. Each plant takes care of about 35,000 sq. ft. of radiation, there being a total of 600,000 sq. ft. in the 18 units.

Barracks are two-story buildings 140 x 43 ft. They have three-column, 38-in. high cast-iron radiators. Three or four radiators in a row are connected at the bottom by a 2-in. pipe, one valve controlling the radiators thus connected. A steam main ends at each corner of the barracks, and is connected into a steam trap which discharges upon the ground under the building.

The second-story squad rooms are heated by 14 radiators, totalling 810 sq. ft. Using a factor of 88 B.t.u. loss per hour per sq. ft. of glass, 24 B.t.u. for exposed wall, and 1.43 loss per hour per cubic foot of contents, these squad rooms would require 762 sq. ft. of radiation to heat them to 70° with outside temperature 10° below zero. The loss through the roof is disregarded, as there is a 4-in. dead air space between the beaver board lining and the roof; this forms a fairly good insulation. The first-story squad room is heated by seven radiators, totalling 385 sq. ft. Using the factors given above, this room would require 380 sq. ft.

The radiation installed in the barracks kept the soldiers comfortable during the cold snaps. At night all upper windows in the squad room were opened and trouble was experienced during the very cold weather from radiators freezing. To conserve the water and fuel and prevent freezing, the steam is now turned off the barracks after the soldiers have retired for the night.

Besides the 18 central heating plants there are 42 individual steam heating plants for officers' quarters and infirmaries, carrying loads of from 280 to 3900 sq. ft. each. These buildings are heated on the two-pipe gravity system, using cast-iron boilers and radiators.

The amusement zone comprises four blocks, 150 x 250 ft., with buildings of a permanent character having stuccoed fronts. There are theatres, restaurants, dry-goods stores, pool hall, shooting gallery, etc., which contain a total of 45,000 sq. ft. of radiation. For this zone a two-pipe vacuum heating system is used. Steam is supplied from a central heating plant of 600 hp. having four 6 x 18 ft. return tubular boilers. No piping is exposed outside the buildings. The steam and hot water supply mains are run in the attic or on the ceilings and drop down under the streets in wood conduit. The return lines for the steam and hot water are run in wood conduit in a trench behind the buildings.

Principal Wire Gages Combined in a Single Table

A table which combines in one series the sizes in the American (B. & S.), Steel, Birmingham (Stub's), British Standard, and Metric Wire Gages arranged in order of diameter of wires, has been issued by the Bureau of Standards as Circular No. 67 under the title "Combined Table of Sizes in the Principal Wire Gages." The table gives the diameter of all the gage numbers in the five systems in mils, inches, and milimeters; also the cross-section in square mils, circular mils, square inches and square milimeters. This table is particularly handy at the present time for those who wish to determine the nearest equivalent in American or British gage sizes of wire specified in milimeters or square milimeters.

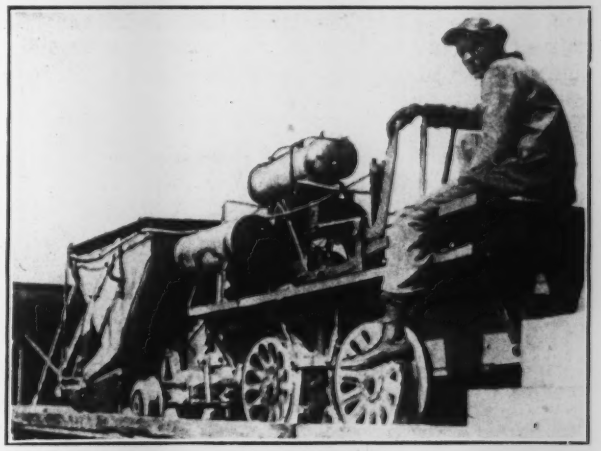
Arch Bridge Is Concreted from Cars on Elevated Track

Two Mixer Plants Serve Side-Gate Cars Dumping Into Traveling Chutes—Trussed Centering Reduces Piling in River

BOTTOM-DUMP cars and a traveler carrying inclined chutes constituted the equipment for depositing concrete in the Court Ave. bridge over the Des Moines River, at Des Moines, Iowa. This bridge is 496 ft. long, with a central arch of 84 ft. clear span, two of 81½ ft. and two of 76½ ft. It is 99 ft. wide between parapets, with a 69-ft. roadway and two 15-ft. sidewalks. Transverse concrete girders on the six arch ribs carry the deck slab, on which is laid the concrete base for asphalt paving. Pile foundations support the piers and abutments. A facing of Bedford stone is used above the springing line of the arches, and includes a cut stone handrail with turned stone balusters.

Materials were delivered on railway cars and were unloaded at the west end of the bridge by means of a stiff-leg derrick with 80-ft. boom. This delivered sand and gravel into stock piles or directly to the bins of the concreting plant at this end of the bridge. It also supplied a small hopper bin from which the materials were discharged into horse-drawn dump wagons which were driven over an adjacent bridge to the concreting plant at the east end of the new structure.

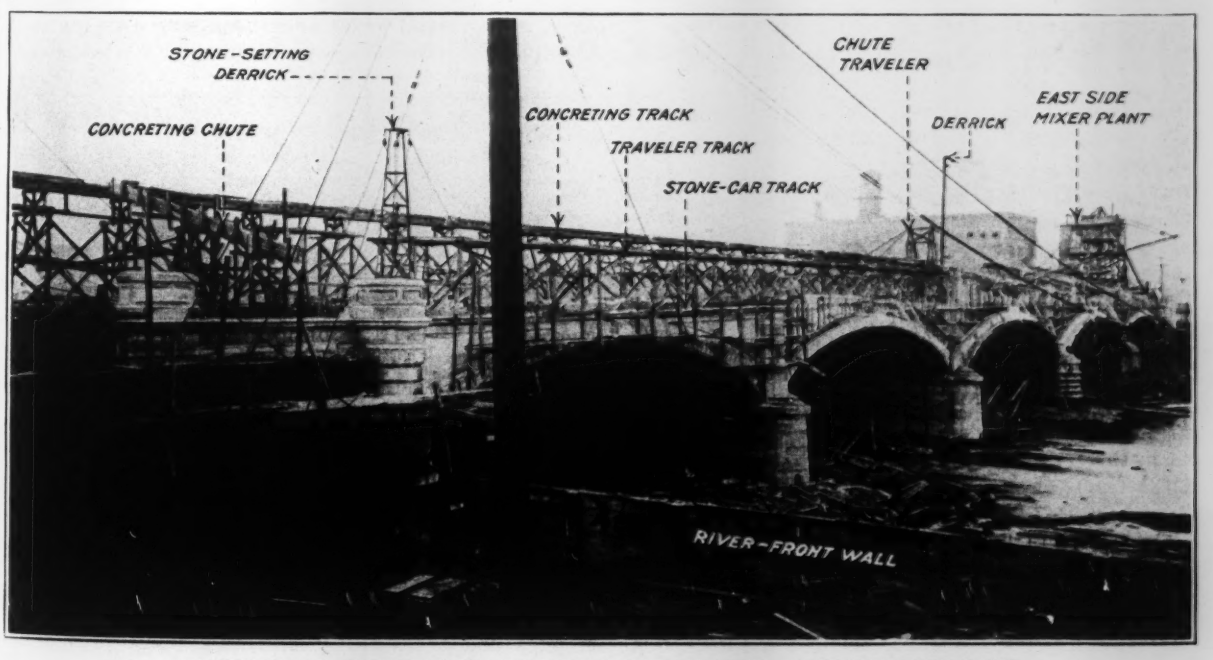
Of the two concreting plants, the principal one was that at the west end of the bridge. This had two bins for sand and crushed stone, elevated about 40 ft. above the ground and fed by the derrick. The height was such as to permit of a series of vertical drops beginning at the bins and ending at the concrete car. Beneath the bins was a 1-yd. hopper for measuring the materials, and below this was a 1-yd. mixer driven by a 20-hp. motor. Under the mixer was a hopper for delivering the concrete to the distributing cars. Cement was unloaded from cars into a shed at the ground level, from which it was delivered to the mixer by an elevator operated by a 5-hp. motor.



OPERATOR OF CONVERTED FORD ENGINE DUMPS SIDE-GATE CONCRETE CAR

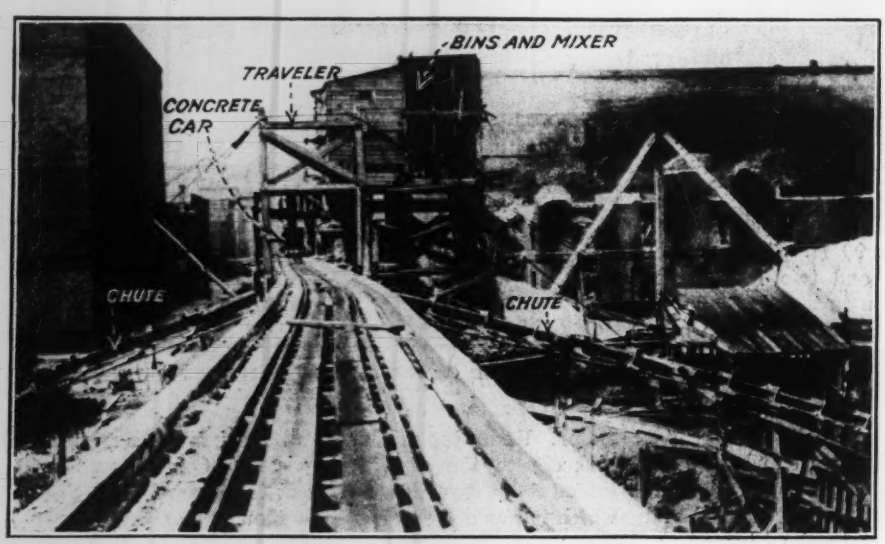
The concreting plant at the east end had a similar arrangement, but its mixer was of ¾-yd. capacity and driven by a steam engine. The sand and gravel delivered here by the dump wagons were supplied to the elevated bins by means of a stiff-leg derrick with 60-ft. boom. While the greater part of the work was done from the west plant, the use of the other plant saved much time, and enabled the east piers to be built before they were accessible from the west plant.

Steel hopper cars with side-discharge gates were used to distribute the concrete. Each plant was served by two of these cars, discharging on opposite sides of a single track. At the west end the cars were handled



CONCRETE ARCH BRIDGE AT DES MOINES HAS UNUSUAL CONSTRUCTION PLANT

—one at a time—by a home-made gasoline locomotive consisting of the machinery of a Ford automobile mounted on a platform having flanged wheels. At the east end, where the haul was short, the cars were moved by hand.



LOOKING ALONG THE BRIDGE SHOWING CONSTRUCTION OUTFIT

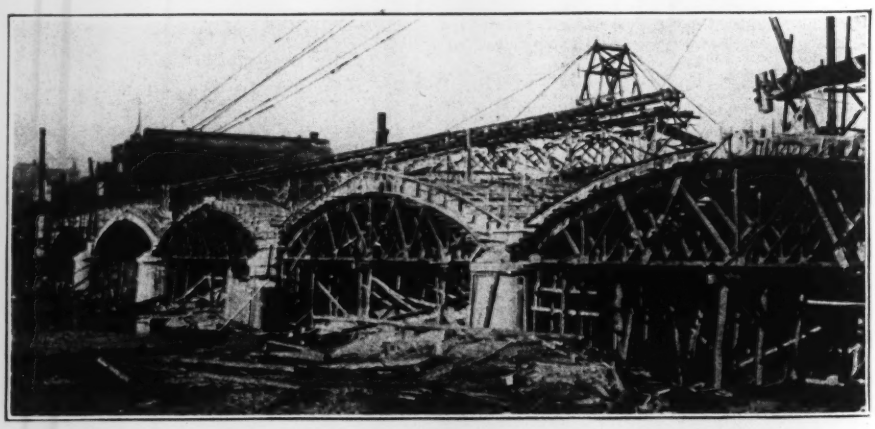
The concreting cars ran on a track of 24-in. gage on a trestle which was built along the center line of the bridge and had its deck sufficiently high above the bridge floor to allow of spouting all the concrete to place by gravity. This trestle was built upon falsework carrying a track of wider gage for a traveler which straddled the concreting track, the traveler rails being about 3 ft. below those of the other track. To each side of the traveler was attached an inclined chute nearly 50 ft. long, of wood construction. Concrete could be taken from each chute at two points in its length by means of metal flexible-pipe drop spouts, which were covered by removable sections of the bottom of the chute when not in use.

An average concreting gang, where the locomotive was used, consisted of 11 men, as follows: 1 operating the cement elevator, 2 loading cement, 1 taking cement from the elevator, 2 feeding cement to the mixer, 1 operating the measuring hopper to feed the mixer, 1 dumping the mixer, 1 operating the locomotive and dumping the car at the chute, 2 spading and tamping concrete in the forms.

An A-frame traveling derrick with 70-ft. boom served the work on the abutment, three piers and three arch spans at the west end. This was mounted on a timber platform 20 x 40 ft., and had separate engines for hoisting and slewing. For the abutment, pier and two arch spans at the east end there was a guyed derrick with 80-ft. boom and a combined hoisting and slewing engine. Two sets of falsework were used; one for taking down the old spans and to carry the A-frame derrick; the other to carry the trusses of the arch centering. With these trusses only five supporting bents were required for each span, thus causing comparatively little obstruction to the waterway. At each end was a framed bent, resting on the concrete footing of the pier, and between these were three pile bents with 18 piles each. The caps of the bents were at the level of the springing line of the arches.

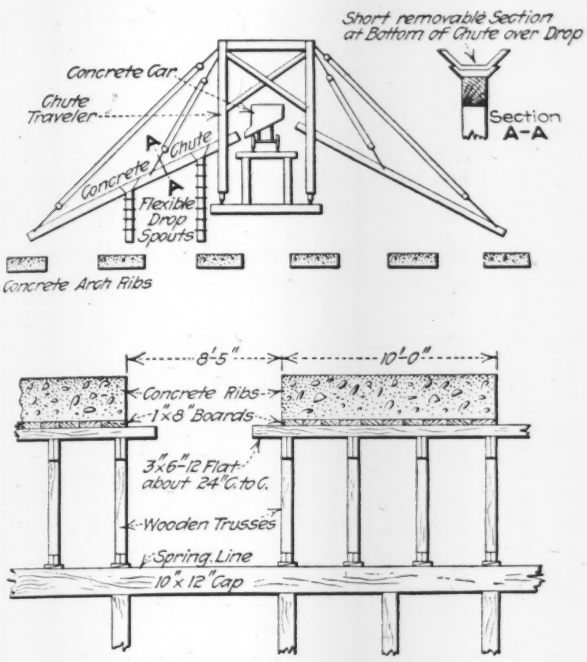
Arch centering for each span consisted of 24 trusses. Three sets of trusses sufficed for the five spans. For each 10-ft. arch rib there were four trusses braced together, and across those were laid 3-in. planks about 24 in. apart to support the lagging of longitudinal planks 1 x 8 in. Strips spiked on the top chords of the trusses gave the proper curve for the arch. The trusses were built on the river bank, floated out to the bridge and set in place by derricks. The centering was left in place for 30 days after the concrete had been placed in the arch ribs.

Cofferdams were built of 4 x 8-in. yellow-pine sheeting in 20-ft. lengths. One edge of each piece had a groove 1 x 1½-in. fitted with an oak spline 1 x 3 in. The pumping was done by two 6-in. steam-driven centrifugal pumps and one 8-in. belted pump of the same type. A steam sheeting-hammer was used for the cofferdams and a steam pile-hammer for the foundation piles. A horizontal boiler of 100 hp. served this work, being placed on the bank, with a 4-in. pipe to the coffer-



CONCRETING OUTFIT AND ARCH FORMS ON DES MOINES BRIDGE

dam. The cut stone for the facing was set as the work progressed, two breast derricks being used for this. The stone was taken out on pushcars on a track of 24-in. gage laid beneath the concreting track. For the arches the stone was placed before concrete was de-



CHUTE TRAVELER STRADDLES CONCRETING TRACK

posited in the ribs, and thus served as the outer side of the form. Each stone is anchored to the concrete by from two to six iron anchors, according to its size.

Contract for the Court Ave. bridge was awarded in December, 1916, at $244,308, including 1200 ft. of river-front retaining wall. By December, 1917, the substructure and all arch spans had been completed, with the floor slab on one span, and work was in progress on the top work of the other spans. The Koss Construction Co., Des Moines, has the contract; Frank Kratoska is superintendent of construction and L. V. Hites is its engineer in charge. The work is being done under the direction of the engineering department of the City of Des Moines, of which John W. Budd is superintendent of streets and public improvements; Karl Kastberg, city engineer, and John M. Tippee, assistant city engineer. The bridge was designed by the Marsh Engineering Co., Des Moines, Iowa.

Many Traction Engines Used in Kansas

On Mar. 1, 1917, 4032 traction engines were in use in Kansas. It is estimated that 6000 to 7000 are now in use. The average drawbar horsepower of the traction engines in use is 12.5, which is equivalent to about 25 brake horsepower. The size most commonly used develops about 20 horsepower. The average owner used his tractor 40 to 50 days last year. The majority of Kansas traction engines are propelled by internal combustion engines using gasoline or kerosene for fuel. Steam traction engines are used to a limited extent for threshing and other heavy belt work. A large average was planned by traction engines in 1916.—From the report of the Committee on Mechanical Engineering, Kansas Engineering Society, Jan. 16, 1917, presented by Dean A. A. Potter, of Kansas State Agricultural College.

Small Town Sewage-Works Operation Problems Analyzed

Results of Inspecting Plants in 39 Cities in Iowa Presented to Engineers of State by Prof. J. H. Dunlap

"SHAMEFULLY NEGLECTED," is generally the verdict on the operation of the small-town sewage disposal plant. Direct testimony from 39 of 100 plants was presented recently to the Iowa Engineering Society by Prof. J. H. Dunlap, who spent three months inspecting the sewage works of the state for the Iowa Board of Health.

Typical findings at some of the plants which have sedimentation tanks and sand filters are given, the figures in parentheses being population, 1915 census.

Ackley (1289): The filters were weedy, the sand ridges between the two beds were broken through, and there were holes in the filters leading directly to the underdrains. Care insufficient.

Albia (5138): The two Imhoff tanks were miniature septic tanks. The slot connecting the sedimentation chamber with the sludge chamber had been clogged and the sedimentation chamber was well sludged up. The flat slab covers made it practically impossible to operate the tanks properly. The filter beds were somewhat out of level, and the distribution was uneven. Care insufficient.

Carroll (4031): The plant consists of two septic tanks and five sand filters. The latter have about reached their normal capacity. The plant was in excellent condition with the exception of some trouble with siphons. It receives regular, intelligent care.

Grinnell (5061): The two Imhoff tanks were found to be sludged up. The four sedimentation chambers were miniature septic tanks. The distribution upon the sand filters was imperfect. Trouble was experienced in removing sludge from the tanks, since no water connections were available. The plant was receiving regular but not intelligent care. The slab covers have now been removed.

Lake View (814): The two filters were somewhat weedy. Soil from the tanks was being washed down upon the surface of the beds. The outfall wall was being undermined. Care received every two weeks.

The impression still remains in the minds of many city officials that septic tanks are cure-alls. In one case these tanks, built in 1913, had been bypassed ever since their construction.

As with the grit chamber, the old-fashioned slab cover close to sewage surfaces with a few manhole openings must be abandoned. The inlet channels to the septic tanks should be so designed that they are self-cleansing. Since most of the Iowa plants suffer from excessive infiltration of ground water during a long period in the spring, ample overflows must be provided, so that the septic tank may never work at an excessive rate. Other points demanded are ample sludge beds, hopper- instead of flat-bottomed tanks, conveniently arranged valves of good design and two tanks, one smaller than the other, to care for the small volumes usually delivered to a new plant.

Marion (4675): The two filters (new plant) showed uneven distribution of sewage. The siphons were giving trouble. No sludge bed. Sludge from septic tanks flushed directly into the creek.

Nevada (2686): Both filters were being bypassed at time of visit. One was still flooded from high water in the creek. The filter beds were badly overworked, operating at least three times the normal rate. In winter the beds are bypassed. The plant receives regular care.

Newton (5165): Serious trouble with gas waste had put both the Imhoff tank and the two filter beds out of commission. The tank had been improperly constructed in the first place with holes at the bottom of the sedimentation chambers instead of continuous slots. The flat-slab cover has been removed.

Sumner (1585): Filters permanently bypassed, since they had been constructed with their drainage system too near the level of the creek.

Tipton (2176): Filter beds badly overworked, flooded recently and the plank distributors floated out of place. With no sludge bed the septic tanks are sludged directly into the creek. The filters are bypassed in winter. Little care.

Toledo (1721): Both filter beds flooded from high water in the creek. In winter the plant is bypassed. No regular care.

Make Imhoff Tank Surfaces Smooth

As with septic tanks and grit chambers, so with Imhoff tanks—the flat-slab cover must be dispensed with. With some plants the side walls of the sedimentation basins must be cleaned and the slots opened once a day. With other plants once a month is sufficient. It is essential in constructing the sedimentation chamber that the surfaces upon which the solids settle should be finished smooth. The slopes of the bottoms of the sedimentation chambers should not be too flat. The slot at the bottom of the chamber should be wide enough to prevent its being clogged by sludge. One large Imhoff tank plant had been constructed without much attention to smooth surfaces in the sedimentation chambers, and ridges between the boards of the forms were in evidence. Two results are sure in such a case. First, the walls and aprons of the sedimentation chambers cannot be cleaned properly. Then, due to the fact that the sludge deposited is not all removed, some of it will become septic, and when gas-filled will rise to the surface, thus interfering with the proper efficiency of sedimentation.

The design must be so worked out that there are no sludge or gas pockets underneath the walls comprising the sedimentation chamber. Such pockets are frequently found in tanks provided with double sedimentation chambers with chimney gas vents between. The sludge and gas collecting in these pockets will eventually cause trouble by coming up through the slot in the bottom of the sedimentation chamber, thus interfering with the fundamental purpose for which Imhoff tanks are designed.

An emergency drain pipe should be so designed and constructed that the level of the sewage in the tanks may easily be lowered below the slots of the sedimentation chambers. In this way tedious and expensive pumping is avoided in case it becomes necessary to empty these chambers in order to clean the slopes and open the slots, or to remove obstinate sludge from the digestion chambers.

Every Imhoff tank ought to be constructed with such connections to water under pressure that the sludge in the bottom of the tank, together with the sludge immediately underneath the bottom of the sludge pipe, may be readily broken up and agitated.

Bypassing Sludge to Creeks Too Common

The flow line of the inlet carrying the sludge upon the bed should be so high above the surface that the sludge will not back into the sludge pipe, and thus ultimately stop it up. Distribution troughs for sludge from either septic tanks or Imhoff tanks are unnecessary. The sludge beds should be as porous as possible. An inch or two of sand upon the top of about a foot of properly graded material is common practice in the large Imhoff plants in the East.

The practice at many plants of sludging out tanks directly into drainage ditches or creeks should be discontinued. Sludge beds should be constructed and used even if pumping is necessary. No direct bypass of sludge to creeks should be included in the design of the plant.

In at least one plant in Iowa the sludge cannot be removed from the siphon chamber without considerable labor, since during construction the inspector did not insist upon the contractor constructing a smooth floor with the proper slope. A bypass for the effluent from sedimentation tanks should be included in the design of the siphon chamber.

The word "automatic" siphon is a misnomer. While such siphons will operate automatically, occasionally for long periods of time, yet at any moment the proper alternation of the siphons may cease. Accordingly all piping, vents, blowoff traps and starting wells should be so located as to be easily accessible. In many plants in Iowa it is so difficult to get at the siphons and their auxiliary connections that they are naturally neglected. Ultimately this means trouble and expense.

A great many filter beds in Iowa are overworked. Engineers differ upon the area which should be provided. The State Board of Health has concluded that under Iowa conditions, with ordinary residential sewage from small towns, intermittent sand filters may be operated at a rate of 200,000 gal. per day. Many filter beds have berms 4 to 5 ft. wide at the top, with slopes $1\frac{1}{2}$:1 around each individual filter bed. When beds are symmetrically located side by side much area may be saved if they are separated by sand ridges 10 or 12 in. high. No inconvenience in operation has been found where this method has been followed consistently.

In selecting sand for sewage filters the State Board of Health should be consulted, as a study has been made of many of the sand deposits in Iowa and the requirements for filter sand have been adjusted to suit average Iowa conditions.

One common fault in the operation of filter beds in Iowa is the uneven distribution of the sewage over the surface of the bed. In general, the tile distributors, especially those consisting of a single line of tile down the center of the beds, were found to be giving better service than plank distributors. The operators of the

plants, however, need instruction as to how to alter the flow through both tile and plank distributors so that equal amounts of sewage may reach equal areas.

In case the filter bed becomes flooded, under no circumstances should holes be made in the sand so that the sewage may find its way directly to the underdrains. This was tried at Grinnell with the result that the underdrains were clogged and the filter beds put out of commission. Spading or plowing of beds should not be permitted. The surface should be stirred only to a depth of ½ in.

Every plant, no matter how small, should have a tool house, and the superstructure of the sedimentation tanks may be so designed as to serve this purpose. This house would afford the operator protection from the weather, and here he may make the reports and carry out the simple tests which ought to be required.

The sludge levels in the sedimentation tanks should be measured regularly. The engineer should leave with the operator devices for this purpose, such as a graduated cord or wire with a weighted board or iron plate attached in such a way as to remain horizontal. No plant visited possessed anything of this kind. Certain industrial wastes must be guarded against. Grease from garages, wastes from creameries and from gas plants must not find their way directly into the sewage-treatment plant.

It is strange in how few plants any idea exists as to the one fact which is most fundamental of all—how much sewage is being handled.

The plant should have every bypass sealed by the State Board of Health. Whenever such a seal must be broken a written report, stating the cause, should be made to the board within 24 hours. For violating this rule Prof. Dunlap suggests that a severe fine or imprisonment, or both, should be fixed by law. The bypassing of sewage-treatment plants has become a matter of course. The dictates of both law and of common sense are thereby transgressed with no compunctions of the community conscience whatsoever. The remedy recommended, though drastic, would correct much of the present carelessness and thoughtlessness.

Four preventives and remedies for the maladies of sewage-works in Iowa are suggested: (1) Proper design should be insisted on. (2) The State Board of Health should require that contracts with engineers for the design of plants should include an agreement to operate them for at least one year after completion. During this period some competent man could be trained to care for the plant, make the proper tests, and fill out reports to the State Board of Health. (3) In instructing the local operator it must be kept in mind that this individual is a more or less transitory character. Accordingly, explicit directions for each detail of operation must be made out. It is a good plan to have such directions framed and hung in the tool house. Some of the engineers of Iowa already are conscientiously leaving such directions, but in no case have they been found at the plant itself. In most instances they were filed away by city clerks and forgotten. (4) Some central authority like the State Board of Health must be in direct control of sewage-works operation and to make this effective more financial support is necessary.

Drum and Track Failure Endangers Important Swingbridge

Stiffeners Buckle and Upper Tread Distorts After Seven Years' Service—Breakages of Wheels Are Frequent

SERIOUS deterioration in a new swingbridge, threatening interruption of an important highway route leading out of New York City and of traffic on an equally important river, has just been reported upon by engineers of the Public Utility Commission of New Jersey. Emergency repairs to insure the safety of the structure were undertaken at once. The turntable of the bridge was found to be in a condition of incipient failure through buckling of the drum stiffeners, although the bridge is only seven years old and the turntable in fact was partly reconstructed in 1912, only two years after completion. Negligence is to blame for part of the present trouble, although inherent weakness in the design is said to be the originating cause. When turntable wheels broke—not a rare occurrence—they were not always replaced promptly, and in some instances track segments were damaged or loosened before the broken wheel was taken out.

The swing span, 295 ft. long by 60 ft. wide (42½ ft. between trusses), is a rim-bearing structure and weighs about 1900 tons. It carries a double-track street-car line which serves a number of large plants engaged in Government work. Two counties own and operate the structure jointly.

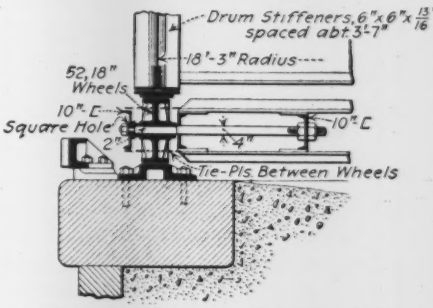


FIG. 2. SECTION THROUGH DRUM AND WHEELS

The photographs in Fig. 1 show the buckling of the drum stiffeners and the distortion of the upper track plate, the critical elements of the situation. The whole circumference of the drum showed similar damage.

The drum, 36½ ft. in diameter by 5 ft. deep, has single-angle stiffeners spaced a little less than 4 ft. (double-angle stiffeners at splices). It is carried on 52 wheels, 18 in. in diameter, journaled on pins fixed in a live-ring 3 ft. wide. The bottom flange of the drum consists of two 6 x 6 x 13/16-in. angles; the upper track plate, 2 in. thick, is tap-bolted directly to these angles. The lower track consists of cast segments of inverted U-shaped cross-section.

The radial girders of the drum connect to a collar that engages the center casting; just below this is another collar braced to the live-ring. At present the upper collar is loose on the pin through wear, and the center casting itself is loose on the pier, its anchor bolts being ineffective o.

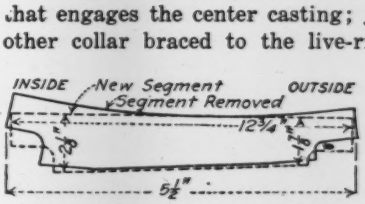


FIG. 3. TRACING OF DISTORTED UPPER TRACK

broken. Whether this condition of the center exerted any influence on the condition of the track or wheels has not been determined.

The inspections made during the last few months, summarized in a report by C. A. Mead, chief engineer of the division of bridges and grade crossings of the Public Utility Commission, disclose "a rapidly progressing condition of failure of parts of the turntable." In August seven drum wheels were broken. In December six broken wheels were in service and 27 new ones were in place, 19 pairs of drum stiffener angles showed buckles (see Fig. 1), and one angle was broken at the summit of the buckle; the maximum stiffener deflection was ¾-in. in a length of 7 in. A month later the greatest stiffener deflection was 1¾ in., and at this time fourteen breaks in the upper track segments were found and the lower flange angles of the drum were seen to be bent up nearly an inch both inside and outside of the drum; two broken wheels were in service.

The buckling of the stiffeners occurred at the foot in all cases. No distortion was noticed farther up, either parallel to the web or at right angles to it. The drum girder thus appears to have adequate web strength and the buckling is evidently due to load concentration at the outer edges of the track.

A track segment which had been removed was traced to show the shape of the cross-section. This tracing is reproduced (in reduced size) in Fig. 3. The upbending of the side portions corresponds with the bending of the drum flange and the buckling of the stiffeners that may be seen in the views in Fig. 1.

The effect of wheel-rolling on the upper tread is held to be primarily responsible for the condition of the bridge, but neglect in maintenance was an important contributory cause. The metal at the contact of wheels and segments appears to have flowed, resulting in a tendency to both lateral and longitudinal bending of the track. As a further consequence abnormal concentration of load took place; the wheel breakages probably were produced by these actions, though some wheels may have broken earlier due to defects and accelerated the destruction of the track. That the lower track was not affected similarly, though its bearing surface is somewhat narrower than that of the upper track, may be credited to the stiffness of its V-shaped section, while the upper track depended for even bearing on the bending resistance of the outstanding legs of the flange angles.

Failure to replace broken wheels at once is not the only point of bad maintenance in the history of the bridge. The bridge has been turned, on at least one occasion, with one one-eighth of the upper track removed.

Only two of the four rack-pinions which turn the bridge were found operative. As originally built in 1910 the turning machinery had only two pinions, but two years later the gearing was rebuilt to provide four. It appears, however, that at some subsequent period a cross-shaft that furnishes power to two of the pinions was put out of service by drawing the key of the driving gear. The entire load of turning is thus carried by the other half of the machinery, and the idle half turns only by being driven from the drum. The two active pinions are seriously worn.

A factor in the case is the necessity for joint action by two counties to initiate any repairs or other changes. This produced serious delay—one county failing to take action even though the other was prompt in doing its part—at a time when the condition of the structure demanded immediate repairs. The Public Utility Commission, which is required to inspect bridges carrying electric railways, secured temporary action through the Public Service Railway Co. when the rapid development of the defects created risk of serious accident. The State Highway Commission has no jurisdiction, according to D. G. Thompson, highway engineer, although the bridge is a very important highway route.

To safeguard the turntable until permanent repairs could be started, the drum flange was stayed by timbers wedged between upper and lower flange. Plans for reconstructing the track include the following items: Increasing the number of wheels to 65 (in place of 52), and riveting vertical diaphragms between the two outer channels of the live-ring, since the tie-plates betwen wheels have to be removed when more wheels are put in; strengthening the outstanding legs of the stiffeners by riveting on a reinforcing bar; placing two cast-steel stiffeners in each space between existing stiffeners; substituting an upper track of special steel for the present soft steel track, and providing new wheels of hard steel.

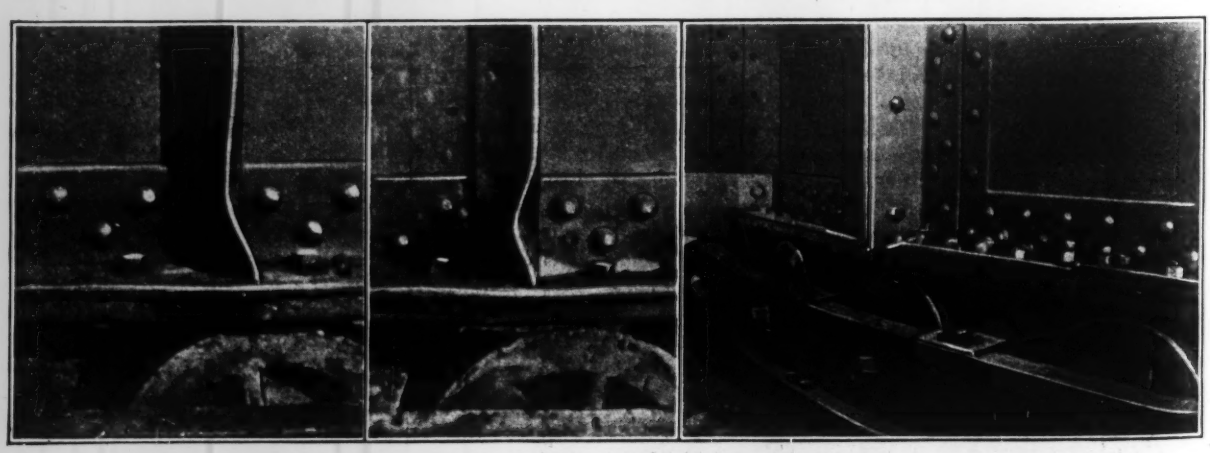


FIG. 1. BUCKLED DRUM STIFFENERS AND DAMAGED TRACK OF 1900-TON SWINGBRIDGE

Transportation Needs—Rail, Water and Highway

Abstracts of Papers Presented in Chicago Last Week at the Convention of the Chamber of Commerce of the United States

Motor Truck Transportation Must Be Developed, Says A. C. Bedford

SAYING that he feels the development of motor truck transportation so important that it should be put into the utmost possible effect, A. C. Bedford, chairman of the board of the Standard Oil Co., told the convention of the U. S. Chamber of Commerce at Chicago that the best use should be made of existing roads, even if no new ones can be built. Mr. Bedford reviewed the gasoline situation, and indicated that the oil industry will meet essential needs by curtailing the use of pleasure automobiles. His address follows in part:

"The question I am called upon to discuss this afternoon, as I understand it, is 'Can the petroleum industry keep pace with the development of auto truck transportation?' I answer, 'it can, and it will, because it must.'

"It was inevitable that motor trucks should become an increasingly important factor in our transportation systems. An instance of this was the successful operation in such a winter as last of a motor truck express route between New York and Philadelphia. Since then the service has been extended to Baltimore, Washington, Boston and other points. When the Government sent 30,000 transport trucks, ordered for shipment abroad, to points of embarkation under their own power, instead of by rail, it relieved about 15,000 freight cars, of a capacity of about 800,000 tons, and also permitted the transportation of 90,000 tons of material to the coast in these trucks, making the total release of freight cars 17,250, of 40 tons capacity each.

"The possibilities opened up by these transportation ventures emphasizes the fact that we must avail ourselves to the utmost extent of the service of the motor truck, and I am hopeful that there will be sufficient gasoline available to provide for all the commercial as well as passenger vehicles during 1918. Even should there be a shortage of gasoline, the development of the auto truck should not be retarded, although it should become necessary to place restrictions on the use of gasoline by passenger vehicles for pleasure uses.

5,000,000 Autos on January 1

"The total automobile and truck registration in the country as of Jan. 1, 1918, according to official figures furnished from all of the 48 states, is 4,941,276. This figure does not include duplicate registrations and, of course, does not include hundreds, and perhaps some thousands of cars in remote districts, all of which are not registered. In round figures, there must have been close to 5,000,000 automobiles and trucks in the country on Jan. 1 this year. The rough estimate prevailing in the motor truck industry, which may be accepted as sufficiently accurate, places the number of trucks in operation in this country at the beginning of this year at 351,000, with current estimates of motor truck output as high as 22,000 per month. Roughly, 5,000,000 motor vehicles in the United States will require about 50,000,000 barrels of gasoline this year. Gasoline exports to the Allies last year totaled nearly 8,000,000 barrels. There will be more this year, so that the total demand made on the petroleum industry for gasoline this year will be over 60,000,000 barrels. In 1917 our production was from 50,000,000 to 55,000,000 barrels.

The Road Problem

"There remains another problem in connection with the further development of motor truck transportation, and that is the problem of the roads. Existing good roads are deteriorating rapidly, for various reasons, and we all known that when deterioration sets in it is exceedingly rapid unless the roads are currently maintained. Thus, the maintenance of existing highways will require large quantities of asphalt or heavy binders, and more good roads are desired and required if truck transportation is to develop its full efficiency.

"The truth, and the trouble, is we have not right now the material necessary for this road construction and road maintenance. Speaking in very round figures, about 1,000,000 tons of asphalts of various kinds are required each year for road work in the United States, and almost half this amount is required for repairs and maintenance alone. But all our asphalt has to be imported with the exception of a comparatively small proportion obtained from California and some Texas crudes, from coal tar, and as byproducts from cracking processes. At this time practically none is being imported, either from Mexico, the big source of asphalt base crude, or from Bermuda and Trinidad, the main sources of natural asphalt. So far as manufacturing capacity is concerned, we have ample, enough to turn out sufficient asphalt to permit of the construction of several thousands of miles of roads.

"There is the additional difficulty of labor for construction and maintenance work on the scale we would like to see. From the viewpoint of the motor truck alone, it would require a large number of men, who probably at this time can be used to better advantage in agricultural, shipbuilding and other industrial work.

"There is also to be considered the large number of men required to operate motor trucks, as compared with the number in a train crew.

"My feeling, then, as regards the road end of the problem, is that the auto truck transportation plan, especially in its relation to the prosecution of the war, is so important that it should be put into effect to the utmost extent possible, making the most possible use of existing roads, even though no new good roads can

be built. With respect to the demand for gasoline for essential purposes, I can only repeat what I said at the outset—it can and shall be met.

"But let me again repeat, because I feel very deeply the seriousness of it — every consumer of gasoline must endeavor to purge himself of his share of reproach because of any unnecessary use or waste of gasoline, remembering there is still great demand for our own and our Allies' war needs.

"In urging you to conserve because of a possible shortage of motive power brings to my mind again a thought that has come to me often lately, and that is that we must also learn to conserve our energy, that indispensable energy which so many people in high as well as lowly positions are wasting by mischievous and idle criticism of the Government's war activities. Our experiences in this respect are not unique. The Governments of none of our Allies have been immume from internal criticism; indeed, we find at the most critical periods of the military campaigns, the civil power in these countries undergoing astonishing changes, and the complexion of the governing body materially altered. It is a tribute, indeed, to the business character of President Wilson's administration that, in spite of innumerable detractors and rumor mongers, he had not lost the confidence of the great body of the American people."

Importance of Highways Emphasized by Roy D. Chapin

THAT the highways can and must play an important part in freight transportation was the point pressed emphatically by Roy D. Chapin, chairman of the highway transportation committee of the Council of National Defense. The motor truck offers wide possibilities for rapid haulage and has the special advantage of taking the shipment direct from the producer to the consumer. One line of usefulness is in saving short-haul movements of railway cars. Many cities have motor truck freight lines operating on regular daily schedules to near-by points, and merchants can assist in relieving the railways by encouraging the use of this local service.

The widest possible use of the motor truck as a transportation agency was approved in a resolution passed recently by the Council of National Defense, this resolution also requesting the State Councils of Defense and other state authorities to take all necessary steps to facilitate this means of transportation, removing an regulations that tend to restrict or discourage such use of the motor truck. Regulation is necessary, but in certain sections there seems to be a tendency to impose laws that are widely restrictive.

The establishment of return load bureaus to reduce the empty movements of motor trucks is an important move based on English practice. Where trucks bring loads into a city and return empty, while other trucks take loads out and return empty, there is a serious waste in transportation.

In Connecticut last fall it became apparent that the motor truck could carry freight cheaply between local points and deliver it promptly, but that the empty return trip was a waste. Therefore "return load bureaus" were established in 14 cities and listed in the telephone books. If a truck is to take a load from Hartford to Waterbury a notice is either sent ahead to the Waterbury bureau or else the truck driver calls up on the telephone when he arrives and asks for a load to Hartford. Usually this can be furnished, as the commercial interests have found this the most prompt means of transportation now available. No charge is made for the service and the bureaus are operated economically at the offices of the local chambers of commerce. The system is being established in many states and cities. The Merchants' Association of New York has appropriated $5000 to institute such a bureau for the service of the great motor truck traffic in and out of New York City.

Motor trucks can be used also to provide a quicker means of getting freight shipments from the freight station to the consignee. This store-door delivery means taking the freight immediately on arrival at the freight house. Thus the station platforms which have become storage floors are converted into clearance floors.

Transportation for farm products where it is difficult or impossible now to get these to market is a potent means of improving the food supply. For example, Maryland has a well developed rural express system of privately owned motor trucks operating on regular schedule over certain routes, picking up at any gate the produce of the farmer and delivering it in the city. The service is daily, regular, dependable and economical. One of the great advantages is that it permits the farmer to market his products easily without the necessity of leaving his farm work and going to the city.

Thousands of trucks headed for France will travel over the roads to port of embarkation, preventing railroad congestion and at the same time giving the drivers much needed training. Snow proved the greatest difficulty last winter, but Mr. Chapin thinks the time is coming when all main traveled routes in the country where traffic is heavy will be kept open all the year round. On such routes heavy falls of snow should not mean that traffic is to be snowbound for days or weeks. An additional reason for snow removal is that highways from which the snow has been removed are in much better shape in the spring and do not break up badly when the frost comes out of the ground.

Francis H. Sisson Discusses Railways and Waterways

A PAPER on "Railway Extensions" by Francis H. Sisson, vice-president of the Guaranty Trust Company of New York, expressed the opinion that recent growth of the railway system has been far too small, and that this condition is the result of a decade of anti-railway legislation and regulation based mainly on ignorance and prejudice. The people have forgotten the great influence of the railways in developing the country and its resources. The Government has made numerous regulations and restrictions, but without any guaranty of returns, so that the railways have suffered in funds and in credit.

Further developments are needed, and there are great resources of coal, oil and farm lands awaiting railways to make them commercially available. Plans for the future must include extension of the railway system,

and also the maintenance and improvement of the existing lines. Shippers are suffering under conditions for which they themselves are largely responsible and it is time for them to take constructive action. The necessary change in the situation rests with the people, through the political representatives they elect.

Government ownership has proved successful nowhere except in Prussia, under military autocratic management. The privately-owned railways of the United States have the lowest rates, highest wages and best service of any railways in the world. But they must be supported and not attacked.

Water transportation was mentioned at one of the meetings, mainly in regard to the utilizing of existing facilities such as the New York barge canal and the lower Mississippi. It was pointed out that whether the canal is or is not an economical investment is not now the question. It exists, and should be utilized to the fullest advantage, to increase the transportation facilities and relieve the congestion of railway traffic.

Unit Operation of Terminal Zones Urged by John F. Wallace

THE terminal problem is the big problem of our railroad transportation system. Its solution lies not so much in enlargement as in the coöperative control of existing facilities in each terminal zone. This was the main idea in the paper presented by John F. Wallace, chairman of the Chicago Railway Terminal Commission. He pointed out that this idea has been presented at various times, but that the railways have had no legal authority to make such a change. Now that the railroads have been taken over by the Government, even if temporarily, it should be possible to provide that each railway terminal zone should be operated as a unit by one local manager, who would have charge of distributing all inbound cars to their destination and delivering all outbound cars to the railways at the limits of the zone.

Through carload freight is frequently delayed from the fact that the cars in passing from one railway to another have to go through terminals and perhaps be handled by intermediate switching or transfer companies and held in various yards awaiting interchange. As the average car travels about 25 miles per day and the average speed of a freight train between terminals is 10 to 15 m.p.h., the car spends 12 hours in the terminals for every hour of movement between terminals. The remedy for this is more direct routeing and especially a routeing that will pass the cars around rather than through terminal points.

In the handling of less-than-carload freight, not only are the shipper and the railway interested, but the municipality also is concerned because the facilities for such freight are usually located at business centers and may restrict the logical growth of the city and cause congestion of street traffic. One improvement, to effect the greatest possible utilization of the land occupied, is to handle the traffic on more than one level. Another is the transfer and grouping of small loads, thus obtaining fully loaded cars for the trains and releasing cars for service. At present the average load of less-than-carload cars is about seven tons.

Passenger terminal facilities at any city should be concentrated at one point. In some places this is prevented by topographic and geographic conditions. In other places the traffic and facilities are too great to permit of such concentration. In the handling of suburban traffic, Mr. Wallace thinks, American railways have been less successful than some European railways and might learn much from a study of the latter. The practice here has been to handle suburban trains in much the same way as through trains, without recognizing the difference in character of the traffic. The two classes of traffic should be kept separate, as in the Chicago district of the Illinois Central R.R., where the suburban trains use neither the tracks nor stations for the through-train service.

Joint or coöperative operation of freight terminals was endorsed in the discussion, and reference was made to a system of this kind introduced at Baltimore, under the direction of a terminal committee composed of railway officers and business men. One phase of the subject is the provision of terminal facilities for electric interurban lines.

Locomotive-Plant Capacity Sufficient, Says Alba B. Johnson

LOCOMOTIVE building plants now existing in this country have ample capacity for the immense production which will be required for home and foreign railways after the war. This was the view expressed by Alba B. Johnson, president of the Baldwin Locomotive Works, in a paper on "Motive Power." That the output has not been equal to the demand at certain periods in the past has been due not to lack of capacity but to the fact that instead of steady business the locomotive building industry has always had either a feast or a famine. Motive power equipment is admittedly inadequate, but under conditions of recent years the railways have not had the funds necessary for purchasing equipment. It is now up to the Government to make or permit rates that will give the railways reasonable returns.

Complete standardization of locomotives is likely to result in hampering rather than expediting the production of locomotives and the operation of the railways, according to Mr. Johnson's views. One reason for this is that locomotives are mainly designed for and operated on certain divisions, and are cared for at division shops which are provided with the necessary repair parts. Consequently, the introduction of new designs and new supplies of additional repair parts would complicate matters seriously. The government committee has recommended twelve standard designs, but these have not yet been approved, and for the present strenuous conditions of operation the railways desire to retain their own standards.

Advantages of standardization are to be found rather in the design of detail parts, to insure interchangeability, and in this way a great work has been done in recent years by the Master Car Builders' and Railway Master Mechanics' Associations. Adoption of complete standard designs for locomotives for the entire railway system would result in obstructing engineering progress, in Mr. Johnson's opinion.

ENGINEERING LITERATURE

A REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

Why Propose Another Classification of Engineering Literature?

Sir—The December proceedings of the American Society of Civil Engineers contains a "Proposed Classification for an Engineering Library Compiled by Eleanor H. Frick and Esther Raymond of the Library Staff" of the "Society Under the Direction of the Secretary, 1916."

It is strange indeed that anyone connected with a national engineering organization should propose a classification of its own for engineering literature in view of the tendency of engineers as a whole to broaden their field. It is particularly undesirable that a suggestion of anything but a classification scheme actually in use should be sent forth, inasmuch as all technical libraries are making every effort possible to coördinate and widen their resources. The greatest practical instrument for carrying this coördination into effect is a common or standard classification.

Are not the authors of this proposed classification aware that of bibliographical classifications alone there have been over 227 schemes designed? Of these the Dewey decimal classification scheme stands out as universal. In one instance it has been expanded to classify over 9,000,000 cards on scientific subjects. In other cases the basic Dewey scheme has been used in specialized libraries to the evident satisfaction of the owners. For specially constructed schemes not based on a standard scheme the writer has yet to see the outline that has survived as successful.

The advice of the recognized leaders in the subject of bibliographical classification repeatedly warns against the adoption of any classification except a standard. It is far better to confine the efforts of experts to the expansion of the so-called "hopeless" divisions of the Dewey classification than to fly off at a tangent and construct one supposedly better. K. C. WALKER.
Formerly with Technology Deparment,
Carnegie Library, Pittsburgh, Penn.

[Mr. Walker's letter was submitted to Chas. Warren Hunt, secretary of the American Society of Civil Engineers, whose reply follows.—Editor.]

Sir—Everybody must sympathize with Mr. Walker's feeling as to the multiplicity of classifications. However, I do not know of any engineering classification which meets with universal acceptance. Perhaps Mr. Walker would be good enough to point out which of the 227 bibliographical classifications he speaks of contains an adequate or satisfactory classification for engineers.

Mr. Walker is quite right in stating that the greatest practical instrument for carrying coördination between technical libraries into effect is a common or a standard classification, but this standard classification must first be had. To say, as Mr. Walker says, that "it is particularly undesirable that a suggestion of anything but a classification scheme actually in use should be sent forth" is to block all progress. No innovation in the established order has ever been made that did not meet with opposition from the unprogressive. Nevertheless, there is room for improvement in almost everything.

Mr. Walker evidently did not read my paper, because the reasons for making the proposed classification are outlined therein.

The Dewey Decimal Classification, which Mr. Walker says stands out as universal, has proved a boon to the libraries and to users of libraries, and, as Dr. Richardson says in his standard work on classification: "It is undoubtedly true that no system ever invented has been applied to as many libraries. . . . The reasons for its deserved popularity are to be found: (1) In an intelligent and consistent application of the decimal notation (not new with Dewey, but first by him vigorously and consistently applied); (2) in the grasp of economic possibilities of this situation; (3) in the practical, intelligent and often up-to-date management of the remoter subdivisions of the, in some places, somewhat artificial larger subclasses; (4) in the fully printed schedules with their "relative index," which more than anything else is the cause of the practicality of this system and its wide adoption. In other words, its popularity has been due to intelligent practical usefulness."

This, however, does not mean that this classification is perfect, and I doubt if any one familiar with the matter would claim such perfection. It is particularly weak in the section devoted to engineering, probably because when this was planned, 40 years ago, engineering was not of the same importance, nor was it specialized as it now is.

A comparison of the main subdivisions under "Engineering" in the Dewey classification and in that under consideration may be of interest:

DEWEY CLASSIFICATION	SUGGESTED CLASSIFICATION
620 Engineering	000 General
621 Mechanical Engineering	100 Civil Engineering
622 Mining Engineering	200 Mechanical Engineering
623 Military and Naval Engineering	300 Electrical Engineering
624 Bridges and Roofs Viaducts	400 Mining Engineering
625 Railroad and Road Engineering	500 Metallurgy
626 Canal Engineering	600 Gas Engineering
627 River Harbor and General Hydraulic Engineering	700 Chemical Technology and Manufactures
628 Sanitary Engineering Water Works	800 Military and Naval Science
629 Other Branches of Engineering	900 All other knowledge

The "Suggested Classification" was worked out after an experience of nearly twenty years in providing data to working engineers, and with intimate contact with the books on the shelves of a large and much used engineering library. Its very title assumes that it is a suggested outline, and it was published with the hope that it would be helpful as a basis for the standard engineering classification which is so much needed; and that constructive criticism might result in a classification that could be used as a standard.

New York City. CHAS. WARREN HUNT.

Two More Miami Technical Reports

STORM RAINFALL OF EASTERN UNITED STATES—By the Engineering Staff of the Miami Conservancy District. Technical Reports, Part V. Dayton, Ohio; The District. Paper; 6 x 9 in.; pp. 310; illustrated. $0.50, or $2 for the five reports.

THE HYDRAULIC JUMP AND BACKWATER CURVES—By Sherman M. Woodward, Consulting Engineer of the Miami Conservancy District, Professor of Mechanics and Hydraulics, State University of Iowa. The Hydraulic Jump as a Means of Dissipating Energy—By Ross M. Riegel and John C. Beebe. Technical Reports, Part III. Dayton, Ohio: The Miami Conservancy District. Paper; 6 x 9 in.; pp. 111; illustrated. $0.50 or $2 for series of five reports.

Two subjects of great importance in hydraulic construction were studied in a radically new manner for the Miami flood-protection project. Their presentation in two new volumes of the District's "Technical Reports" supplies new data in hydrology and hydraulics which demand a prominent place on the reference shelf.

How great a flood rainfall may be expected in the northeastern quarter of the United States? The answer to this question, detailed in the 310 pages of one of the new volumnes, is bound to exert a lasting influence on futrue thought and planning which deals with rivers, storage works and valley improvements. Proof that precipitations reaching eight or ten inches of depth in four to five days may occur once in three or four generations over drainage basins of several thousand square miles cannot fail to bring about more ample provision for emergency flood flow than many valleys now have. The data and their analysis merit careful restudy by every hydrologist.

Utilizing the hydraulic jump for showing up the high-velocity discharge of the Miami detaining basins was possible only after full investigation of water-flow profiles and jump conditions. Theory and experiment were combined in unusually successful manner in the course of this investigation. Professor Woodward's analysis of flow profiles or backwater curves gives for the first time a comprehensive survey of the subject, and as he handles the subject without calculus aid, and shows accurate drawings of the several flow-curve types, his monograph constitutes a new and much-needed textbook in the field of hydraulics. The model experiments on the hydraulic jump are of even greater importance, perhaps, from the viewpoint of direct practical value. Besides confirming the theory of the jump, they give a remarkable picture of the modifying conditions. Design of jump channels in practice can be based on the data here furnished with a satisfactory degree of reliability, it would seem.

Reclamation Service Tables Expanded

HYDRAULIC AND EXCAVATION TABLES—Fourth Edition, Revised and Enlarged. Washington, D. C.: U. S. Reclamation Service. Imitation leather; 4½ x 7 in.; pp. 168, $1.25. Remit by postal or express money order, New York draft or certified check.

Originally published in 1905 for the benefit of the Reclamation Service, these handy tables have proved useful to other engineers as well and have been conciderably expanded in successive editions. Most of the tables were computed for this book and are not available elsewhere. Tables from other sources have been added to round out the volume, but most of these have been modified or extended to conform with reclamation project conditions. The second edition was noted in *Engineering News*, June 16, 1910. A third edition appeared in 1913. The tables now include velocities computed from Kutter's formula, with n ranging from 0.010 to 0.035, a table for $n = 0.011$ having been computed as "sometimes applicable to steel flumes of the smooth interior type"; hydraulic functions of canal, flume and conduit sections; discharges of pipe; stadia and other tables. The tables for flow through pipes are new, those for wood stave pipes being based on the formula of Fred C. Scobey and for other materials on the Hazen-Williams formula. The range of velocity heads given has been expanded by "an extended set of values for small heads."

Water Rates and Problems

METER RATES FOR WATER WORKS—By Allen Hazen, S. D. M. Am. Soc. C. E. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6 x 9 in.; pp. 217; illustrated. $2.25.

At a time when it is more important than ever that water shall be sold by meter measurement to prevent waste, reduce coal consumption—where water is pumped—postpone necessary enlargements of water-supply system on the one hand and on the other effect a just distribution of the burden of providing water service, this important monograph by Mr. Hazen is most timely and should prove to be stimulating and eminently useful.

The nucleus of the book or, as the author himself puts it, the "starting point" was the several reports of the Meter Rates Committee of the New England Water-Works Association made not long ago under the leadership of Mr. Hazen as chairman. As the progress reports of the committee were discussed fully at meetings of the association and the resulting final report was at last adopted by the association, the volume has a solidity and a breadth of appeal which perhaps could have been obtained in no other way. Moreover, in preparing the book the author has drawn upon the engineering practice of himself and his firm in dealing with water-rate problems which have arisen in framing new rates and in studying old ones involved in litigation and valuation work.

A liberal use of diagrams is a feature of the book. A considerable number of schedules of water rates, besides other statistical data, is also presented.

Brief chapters on the reasons for using meters, the beginning of metering and forms of meter rates now in use take up the first 26 pages of the volume. Forty pages are then devoted to text and diagrams, under the chapter heading "Graphical Comparison of Meter Rates." The diagrams presented, as also some of the others in the book, are plotted on logarithmic paper.

At this point the author introduces a few pages describing the New England Water-Works Association form of meter rates, as adopted Nov. 6, 1916. This form was suggested "as an ideal to be approached whenever meter rates are being revised and to be incorporated in full or in part as might be found feasible or advantageous." It "recignizes the principle of the sliding scale and provides three rates. These rates are not fixed, but are left to be determined for each case as may be necessary to provide the required revenue. . . . . In addition a service charge is provided." The three rates are designated as domestic, intermediate and manufacturing. The committee suggested but did not recommend an alternate procedure for use where there was an objection to the service charge. "Under it'„ the

author states, "the amount that would otherwise be used as the service charge is ascertained and this amount is applied as a loading to a small amount of water first sold from each service, thus making in effect a fourth and higher rate for use only where no service charge is made. Mixing metaphors somewhat, this may be described as heating the devil around the stump for the benefit of those who prefer a rose by some other name. To say this is of course not to criticize either the committee or Mr. Hazen, but merely to resognize the human weaknesses of many water consumers and city officials.

The next four chapters deal with what the author calls "the minimum rate," the service charge, the form of "minimum rate" based on frontage of the property supplied and a comparison of various forms of meter rates.

The use of the term "minimum rate" seems unfortunate. The author starts off his chapter on this subject very properly by using the preferable term—"minimum charge." It seems a pity that he did not stick to this throughout, thus reserving the term "minimum rate" to be used in its common significance as opposed to the maximum rate.

The breadth of the book is shown by the fact that it really goes far beyond the mere question of rates, although considering nothing that is not pertinent to a comprehensive discussion of the subject. Thus, we have considered in succession, services and meters (which include such matters as ownership of each) water that cannot be accounted for, leakage from street mains, under-registration of meters, "whether the scale should slide," and the "three-charge rate." In taking up the last-named subject the author reverts briefly to the New England form of meter rates.

Successive chapters deal with making rate schedules, fixing meter rates for systems not already metered, extra rates for high-service districts, and questions involved where there is competition between the public supply and local or private supplies.

Good as the book is, it would have been better if it had been prefaced by an introduction presenting a bird's-eye view of the whole subject, including particularly the principles governing the distribution of the cost of water service between the general public on the one hand and private consumers on the other. Perhaps the book says quite all that needs to be said on these and some other subjects connected with the distribution of the water-works burden, but the statements presented regarding the principles involved seem rather scattered. Possibly the chapters of the book might have been more logically arranged. This would not have mattered so much had there been an introductory survey of the whole subject. The need for an introduction is perhaps greatest for the readers, of the book who are not engineers and not conversant with the literature of meter charges.

Handbook of Chemistry Enlarged

THE CHEMIST'S POCKET MANUAL: A Practical Handbook Containing Tables, Formulas, Calculations, Information, Physical and Analytical Methods—By Richard K. Mead, M. S., Analytical and Consulting Chemist and Chemical Engineer. Third Edition. Easton, Penn.: The Chemical Publishing Co. Leather; 4 x 6 in.; pp. 514; illustrated. $3.50.

In a review of the second edition of this handbook, which appeared on page 47 of the Engineering Literature Supplement to *Engineering News* of Nov. 17, 1910, it was stated that while the book as it then stood contained much of value to the engineer having to do with chemical matters, it was essentially a work for analytical chemists. In the present edition is stated in the preface: "That portion of the manual devoted to chemical engineering, as well as that to analytical chemistry, has been materially enlarged, so that while still serving the analyst, it is believed that the chemical engineer will find in this edition much of use also."

The volume as it now stands contains 87 pages more than did the second edition and is two and a half times as large as the first edition, which appeared in 1900. New material designed particularly for the chemical engineer has to do with "fuel, boilers, engines and chimneys, drying and evaporation, firebrick and refractories, heat conductivity and resistivity, tanks, piping and pumps, belts, pulleys and shafting, elevators and conveyors." The book contains a large amount of useful chemical information and is handy in size.

England's Promise to Labor

THE RESTORATION OF TRADE UNION CONDITIONS—By Sidney Webb. New York: B. W. Huebsch. Paper; 4 x 7 in.; pp. 106.

No man has a better understanding of the English mind when it deals with industrial and labor problems than Sidney Webb, who, with his sister Beatrice, has written the most authoritative works on unionism as it is manifest on the British Isles. Therefore his analysis of the British Government's pledge to the trade unions that if they would abandon their protective network of usages and regulations for the period of the war these would be restored absolute and intact upon the advent of peace, will be read carefully and considered at its full weight by all reasonable and far-seeing British employees. Its value to the American employer is more remote, but certainly it is not without value if we expect to benefit by the experiences or mistakes of our allies.

But absolute restoration, the author points out, is utterly impossible, not only because of changed conditions but because no record has ever been made of what constituted the network of usage and regulations which were in force at the outbreak of the war. Except as an academic demand that pledges be fulfilled, the author does not expect that labor will ask that restoration be attempted. Nor will the manufacturer, who has learned the use of automatic machines and the advantage of divided tasks, willingly go back to old conditions of limited output and slow capital turnover. On the contrary, many employers have publicly announced that they will not consider themselves bound by any such archaic rules as were in force previous to August, 1914.

To this student of industrial conditions there seems very little doubt that labor will be, in some way or other, cajoled into an acceptance of a modification of the Government's pledge. This "great betrayal"—for anything other than a complete restoration is certain to be so labeled—will prove to be, in the opinion of the author, the cause of destructive social illness in the English body industrial.

Recognizing, then, that restoration is not possible, and that the English worker must be made to feel that

he has not been done out of his previous and hard-earned advantages through an appeal to his patriotism, an outline of what might be called a new Magna Charta is given as Chapter 5 of the volume. In brief, this new industrial constitution will consider the problem under five heads: (1) The prevention of unemployment by the scientific study of private industrial and public-works demand for labor so that the aggregate wage total of the kingdom will not vary fro myear to year; (2) the maintenance of the standard rates against any desire of the employer to cut them through the introduction of automatic machinery or the splitting up of tasks; (3) the adoption of a constitution for factory and industry, which should provide for a universal acceptance of trade unionism, and the recognition of workshop committees, or shop stewards; (4) the abandonment of the English workman's almost inherent tendency to limit output, which, as the author shows, can be accomplished by abolishing nonemployment and maintaining standard rates of wages; and (5) the guarantee of freedom for every employer to engage any person whatever for any sort of work, at the same time granting to all workers the right to engage in any task, but never at less than the standard rate.

Relief Work After Great Disasters

DISASTERS AND THE AMERICAN RED CROSS IN DISASTER RELIEF—By J. Byron Deacon, General Secretary, Philadelphia Society for Organizing Charity (on Leave of Absence) Division Director of Civilian Relief for Pennsylvania and New York: Russell Sage Foundation. 5 x 8 in.; pp. 230. 75 cents.

As the subtitle indicates, this volume deals primarily with Red Cross relief work after great disasters. The volume is given interest and practical point by descriptions of relief work actually done after such disasters as the sinking of the Titanic, the Cherry mine fire, the Ohio floods, forest and factory fires and the San Francisco fire. Separate chapters deal with the principles of organization for disaster relief. The importance of health-protective work in the case of such disasters as floods and some fires is emphasized but the methods to be employed are not given in detail—partly, it may be assumed, because state and national agencies are generally new and have to look after such matters.

Rare and Standard Scientific Books

Many old and rare as well as standard books in "Exact and Applied Science" are listed in Catalogue No. 770 of Henry Sotheran & Co. (140 Strand, W.C. 2, London, England; 2½ shillings). Some of the books are from the library of the noted British engineer, Sir George Rennie (1791-1866). The catalogue has sections on engineering, mathematics, astronomy and geodesy, meteorology and physical geography, chemistry, mining and metallurgy and learned society proceedings, combined with scientific journals.

PUBLICATIONS RECEIVED

[So far as possible the name of each publisher of books or pamphlets listed in these columns is given in each entry. If the book or pamphlet is for sale and the price is known by the editor the price is stated in each entry. Where no price is given is does not necessarily follow that the book or pamphlet can be obtained without cost. Many, but not all, of the pamphlets, however, can be secured without cost, at least by inclosing postage. Persons who are in doubt as to the means to be pursued to obtain copies of the publications listed in these columns should apply for information to the stated publisher, or in case of books or papers privately printed, then to the author or other person indicated in the notice.]

THE AMERICAN LABOR YEAR BOOK 1917-1918—Edited by Alexander Trachtenberg, Director, Department of Labor Research, Rand School of Social Science. New York: The Rand School. Cloth, 5 x 7 in.; pp. 379. $1.25.

FINDING AND STOPPING WASTE IN MODERN BOILER ROOMS: A Reference Manual to Aid the Owner, Manager and Boiler Room Operator in Securing and Maintaining Plant Economy—Philadelphia, Pa.: Harrison Safety Boiler Works. Flexible Cloth; 5 x 7 in.; pp. 270; illustrated. $1.

An expansion of useful information originally intended as an appendix to a trade catalogue of V-notch meters. Contains sections on fuels, combustion, heat absorption, boiler efficiency and testing, boiler plant proportioning and management and Cochrane meters, the latter filling only half a dozen of the 270 pages. Many tables and charts.

HANDBOOK OF HYDRAULICS: For the Solution of Hydraulic Problems—By Horace Williams King, M. Am. Soc. C. E., Professor of Hydraulic Engineering, University of Michigan. New York: McGraw-Hill Book Co., Inc. London: Hill Publishing Co., Ltd. Leather; 4 x 7 in.; pp. 413; illustrated. $3.

HOW TO MEET HARD TIMES: A Program for the Prevention and Relief of Abnormal Unemployment. New York: Municipal Reference Library, Municipal Building. Paper; 7 x 10 in.; pp. 127. 25c.

IRON ORE, PIG IRON AND STEEL IN 1916—By Ernest F. Burchard, Washington, D. C.: U. S. Geological Survey. Paper; 6 x 9 in.; pp. 57.

MECHANICS OF THE HOUSEHOLD: A Course of Study Devoted to Domestic Machinery and Household Mechanical Appliances—By E. S. Keene, Dean of Mechanic Arts, North Dakota Agricultural College. New York: McGraw-Hill Book Co., Inc. London: Hill Publishing Co., Ltd. Cloth; 6 x 9 in.; pp. 383; illustrated. $2.50.

OFFICIAL YEAR BOOK OF THE COMMONWEALTH OF AUSTRALIA: Containing Authoritative Statistics, 1901-16, and Corrected Statistics, 1788-1900—By G. H. Knibbs, C. M. G., Fellow of the Royal Statistical Society. Melbourne, Australia: Bureau of Census and Statistics. Cardboard; 6 x 9 in.; pp. 1168.

PROVINCIAL BOARD OF HEALTH OF ONTARIO, CANADA: Report for 1916—Toronto, Can.: The Board. Cloth; 7 x 10 in.; pp. 371; illustrated.

PUBLIC SERVICE COMMISSION, SECOND DISTRICT: Report for 1916. Abstracts of Reports of Corporations Electrical Gas, Telegraph, Telephone, Steam. Albany, N. Y.: The Commission. Cloth; 9 x 12 in.; pp. 323.

RAILROAD COMMISSION OF CALIFORNIA: Report 1916-17. San Francisco, Calif.: The Commission. Cloth, 6 x 9 in.; Vol. 1, pp. 340—Vol. 2, pp. 657.

STEEL AND ITS HEAT TREATMENT—By Denison K. Bullens, Consulting Metallurgist. Second Edition. New York: John Wiley & Sons, Inc. Cloth; 6 x 9 in.; pp. 472; illustrated. $4.

Quite a few revisions distinguish the second edition from the first—reviewed in these pages Aug. 17, 1917, by C. J. Yarnall. The section on forging shows enlargement. Numerous photomicrographs have been added in various parts of the book.

TRANSIT COMMISSIONER OF PITTSBURGH: Report for 1917—Pittsburgh, Penn.: The Commissioner. Cloth, 9 x 12 in.; pp. 180; illustrated.

A TREATISE ON ROADS AND PAVEMENTS—By Ira Osborn Baker, Professor of Civil Engineering, University of Illinois. Third Edition. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6 x 9 in.; pp. 658; illustrated. $4.50.

WASHINGTON SUBURBAN SANITARY COMMISSION: Report on the Advisability of Creating a Sanitary District in Maryland, Contiguous to the District of Columbia, and Providing It with Water and Sewerage Service—Address: Robert B. Morse, Engineer to the Commission and Chief Engineer to the Maryland State Department of Health, Baltimore, Md. Paper; 7 x 10 in.; pp. 103; illustrated.

The sanitary district proposed in this report has an area of about 95 miles, compared with 70 miles in the adjacent District of Columbia, and a population estimated at 32,000 now and 150,000 in 1950. Comprehensive water-supply and sewerage systems are advised in a detailed report by Robert B. Morse.

WATER-SUPPLY AND SEWERAGE PAPERS. Reprints from 1915 annual report, Vol. III. The New York State Department of Health (Albany, N. Y.). Paper; 6 x 9 in.; illustrated.

THE DESIGN OF SEPARATE SYSTEMS OF SEWERAGE FOR VILLAGES WITH SPECIAL REFERENCE TO NEW YORK STATE CONDITIONS—By C. A. Holmquist, Assistant Engineer. pp. 15.

THE DISPOSAL OF CREAMERY WASTES—By C. A. Howland, Inspecting Engineer. Pp. 15.

EFFECT OF CALCAREOUS MATERIAL IN SOILS AND ROCKS ON THE AMOUNT OF NITRATES IN GROUND AND SURFACE WATERS—By M. F. Sanborn, Assistant Engineer. Pp. 26.

EMERGENCY CHLORINE STERILIZATION PLANT FOR PUBLIC WATER-SUPPLIES—By E. Sherman Chase, Assistant Engineer. Pp. 7.

LIQUID CHLORINE DISINFECTION OF WATER FOR POTABLE PURPOSES—By C. M. Baker, Assistant Engineer. Pp. 22.

REDUCTION OF WATER-BORNE TYPHOID FEVER—By Theodore Horton, Chief Engineer. Pp. 10.

THE RELATION OF SEWERAGE SYSTEMS TO THE PREVALENCE OF TYPHOID FEVER—By H. Burdett Cleveland, Principal Assistant Engineer. Pp. 3.

A STUDY OF THE APPLICATION OF THE SCORE SYSTEM TO THE SANITARY QUALITY OF PUBLIC WATER-SUPPLIES IN NEW YORK STATE—By Theodore Horton, Chief Engineer and E. Sherman Chase, Assistant Engineer. Pp. 15.

SOCIETY SERVICE

A Section Dealing with the Results of Teamwork by Technical Men

Pittsburgh Engineers Take Active Interest in Civic Affairs

Road construction and improved street traffic conditions are subjects receiving the attention of the Engineers' Society of Western Pennsylvania. Conferences have been held with W. M. Donley, road commissioner of Alleghany County, on the question of new construction and maintenance of the 529 miles of road within the county. Large quantities of fuel, mill supplies, food and military necessities must be moved rapidly over certain main arteries, and to keep these in repair, and to carry out the 1918 program for new work, will require the release of railroad equipment. Contracts have been awarded covering practically all this work, and funds are available without the sale of additional bonds. In a letter addressed to the Secretary of Agriculture the society has gone on record as favoring the 1918 program as above outlined.

The transit commissioner of Pittsburgh has made a report on vehicle congestions with recommendations as to changes which will give immediate relief for the downtown district. The society endorses this action, and has sent its approval to the mayor and city council.

Both of these matters were the subject of extended investigation and conference by a newly organized committee on civic affairs, which purposes to render all possible support to the executive and legislative branches of the local government in a spirit of service to the community. The committee consists of Samuel E. Duff, chairman; K. H. Talbot, vice-chairman; J. H. Minton, George W. Nichols, G. M. Lehman and W. B. Spellmire.

St. Louis Engineers a Civic Factor

Good roads, riverfront improvement, smoke abatement and appointment of engineers to public positions were activities participated in to some avail by the Engineers' Club of St. Louis in 1917. Road legislation when up in the city, county or state was looked into carefully and several changes defining the qualifications and duties of county highway engineers to which the club took exception were eliminated. The bill as finally passed, states the report of the good roads committee, gives the engineer much more authority than hoped for.

Work of the club on riverfront improvement in conjunction with the City Plan Commission, resulted in definite recommendations on four of the more important features on which engineers had opinions crystallized. Consideration of river utilization to relieve railroad congestion is a most timely subject.

A smoke abatement ordinance drawn up by a committee of the club was passed by the board of aldermen. It was then asked to name a man for the office of inspector of boilers and elevators having charge of smoke regulation. This it did after going over the field of qualified and available men. The selection was approved and appointment followed.

The civic committee was instrumental in inducing the Governor to continue an engineer as a member of the State Public Utility Board. The same committee urged the Governor of Illinois to appoint an engineer in charge of the new Board of Public Works, but in this case it was unsuccessful. Much other work has been done, such as service on the conscription board and aid to the Government in seeking engineering and financial assistance in drives of the Liberty Loan and Red Cross. It is the creed of this committee, headed by A. P. Greensfelder, that the club will be called upon by the community only when it indicates a willingness to serve.

Young Men Urged to Attend Society Meetings Regularly

Attendance of the younger members at its meetings is being urged by the Western Society of Engineers. A recent bulletin points out that regular attendance is of advantage to these men not only in the technical information they may gather, but also in the opportunity for interchange of ideas and increased acquaintance with fellow engineers. Further, it enables them to acquire a readiness to take part in technical discussion, which is of advantage in many ways. The bulletin points out that it is wise for a man to attend all the meetings as far as possible, and not to limit his attendance to those for which subjects of direct interest to him are announced. Reference is made to an engineer who found this plan of particular advantage in that he acquired much information on subjects that appeared of little interest before attending the meeting. Such information later proved extremely useful.

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Use of Minimum Stream-Flow Records

Sir—I have read Dana M. Wood's letter in your issue of April 4, p. 675, and can find no objection, however slight, to the subject matter of my article on p. 359 of your issue of Feb. 21. His use of the words "misleading" and "erroneous" is not understood, since he endorses an essential point in my paper.

Under the subhead "Some Questions Interjected" I asked the question: "What water power has been developed considering abnormal minimum flow"?—referring, of course, to limitation of plant capacity. Mr. Wood says *none* in his experience of 12 years, and I say *none* in an experience of more than 40 years. This reference contemplates water power using all the flow of a stream.

I do not discuss the utilization of water power or the necessary auxiliary means respecting the variations in the flow of streams, the principal subject of Mr. Wood's paper, but specifically refer to the dependable character of the supply of water for stream flow.

We are promised in Holy Writ that "while the earth remaineth, sunshine and rain shall not cease," from which we may infer that a normal yearly amount is fixed

by nature, considering long periods of time and recorded observations. Yearly and seasonal variations in rainfall concern us most in water-power development, and this is the subject proper of my paper.

Except as showing common practice in water-power development, substantiating my contention, the third paragraph of Mr. Wood's paper and all that follows discuss a subject germane only to the matter treated in my paper; but, in a recent letter, *Engineering News-Record*, March 28, p. 628, Mr. Wood treats the subject my paper; but, in a recent letter, *Engineering News*- and 15% for median values, that I give in my paper for this specific purpose, p. 359, second column, last paragraph. This shows that Mr. Wood and I are studying along the same lines. GEORGE E. LADSHAW.

Spartanburg, S. C.

Determining the Best Angle of Abutment Wing Walls

Sir—The article on the design of wing walls for bridge abutments by C. K. Mohler, in the Jan. 24 issue, should be of value to all engineers interested in abutment design, for the writer calls attention to points in design which are too often slighted, not only in railway work but in highway work as well. Mr. Mohler brings out facts which admit of no argument and which, it would seem, should be universally known to and accepted by the members of the profession. That these facts are not universally known and accepted is evidenced by the many improper wing-wall designs which have increased the cost and detracted from the appearance of the finished structure.

Mr. Mohler points out that by placing the wing at an angle with the abutment face the wing length may be shortened and a saving in material effected, but does not mention the wing angle which should be used in order to secure the minimum wing length. Where the intersection of the face of the wing and the face of the abutment are in line with the shoulder of the fill, it can be demonstrated mathematically, if the thickness of the end of the wing wall is neglected, that for a minimum wing length the face of wing should bisect the angle between the shoulder of the fill and the face of abutment produced. In Fig. 1, for minimum wing length L, the wing angle α should equal $\frac{1}{2}\beta$. A slight variation in the angle α does not materially affect the wing length.

In the design of the standard abutments of the Iowa Highway Commission the restraining action of the wings on the main body of the abutment is taken into account, resulting in a considerable saving of concrete. With this type of design it is doubly important that the wings be turned back at approximately the correct angle, as otherwise material is wasted, due not only to the increased wing length but also to the necessity of increasing the abutment section to secure the necessary stability.

One of the features of the standard abutment designs of the commission is the wing railing. The top of the wing wall is carried out horizontally for five or six feet before the wing drop is commenced, and on this horizontal portion is placed a railing, the type of railing depending on the type of superstructure. Concrete wing rails are used for concrete slab and girder superstructures and for I-beam spans with concrete rails, heavy gas-pipe wing rails for steel truss superstructures and for I-beam spans with pipe rails, and steel angle wing rails for I-beam spans with angle rails.

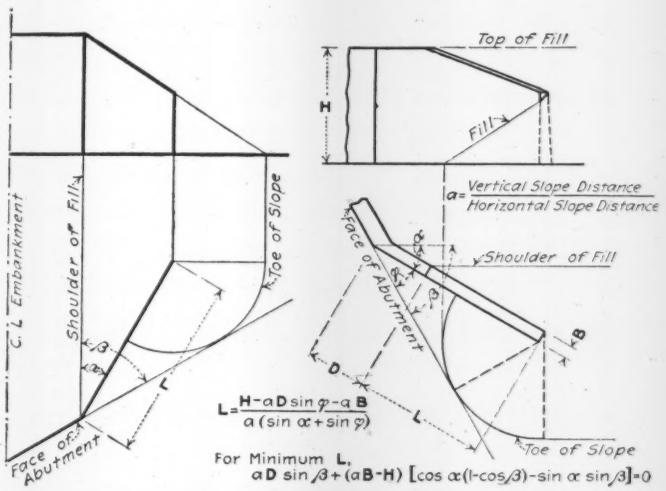

C. L Embankment
Shoulder of Fill
Toe of Slope
Face of Abutment
L
β
Top of Fill
H
Fill
α = Vertical Slope Distance / Horizontal Slope Distance
Shoulder of Fill
Face of Abutment
D
B
L = (H − aD sin φ − aB) / (a (sin α + sin φ))
For Minimum L,
aD sin β + (aB − H) [cos α (1 − cos β) − sin α sin β] = 0

FIG. 1. ORDINARY WING-WALL CASE

FIG. 2. WING WALL OF IOWA TYPE

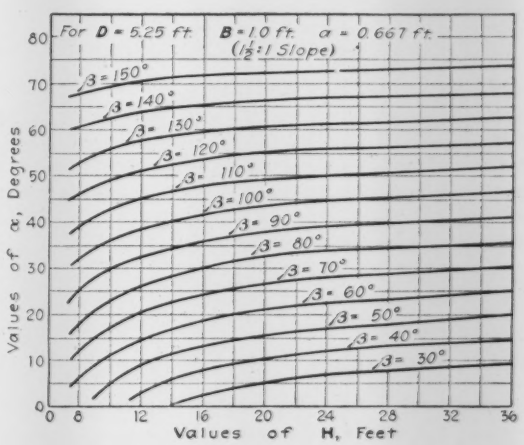


FIG. 3. ANGLE FOR MINIMUM WING LENGTH

value of the angle B, but also upon the height of fill. which with the rail adds to the safety of vehicles approaching the bridge, while the wing railing itself adds considerably to the appearance of the structure. The accompanying photographs show typical examples of this construction.

In determining the wing angle which will result in a minimum length for this type of wall, the length D of the horizontal portion (Fig. 2) and the thickness of the end of the wall must be considered. The value of the angle α is now not only dependent upon the value of the angle, δ but also upon the height of fill. The diagram Fig. 3, based on the values 5.25 ft. for D, 1 ft. for B, and 0.67 for a (1½ to 1 slope), gives the values of α corresponding to the minimum wing length,

HANDRAIL EXTENDED ALONG HORIZONTAL PART OF WING WALL AS PROTECTION TO TRAFFIC

for various values of β and various heights of fill. The diagram shows that the angle α is always less than $\frac{1}{2}\beta$, that it increases with the height of fill, and that it approaches more nearly to the value of $\frac{1}{2}\beta$ as the angle β increases. An increase in the length D decreases both the value α and the value of the length L, but increases the total length of wing.

Although it is manifestly undesirable in the great majority of cases to use a wing angle which will result in the absolute minimum wing length, yet the diagram offers a valuable guide in choosing the wing angle to be used. For values of constants varying by any great amount from those given above it would of course be necessary to prepare other diagrams.

E. F. KELLEY.

Assistant Bridge Engineer, Iowa State Highway Commission, Ames, Iowa.

Believes Design of Slab Responsible for Bridge Collapse

Sir—In your issue of March 28, p. 619, you show photographs of a bride collapse ascribed to earth subsidence. The article which accompanies the photographs gives as the probable cause "a sliding of the stratified gravel upon itself." A collector of statistics of failures would, in all probability, put down this failure as due solely to foundation. Perhaps not one engineer in a hundred in reading this article and looking at the pictures would raise any question. To me the photographs bear evidence of quite a different cause.

There might have been a little settlement of the foundations, but I hold that a properly designed reinforced-concrete bridge could not fail in this manner; also that the photographs show that this bridge was not properly designed. The middle view would seem to indicate that there was a construction joint close to the pile cap or girder, for the break is quite square. This would look like bad execution in addition to bad design. The view does not show any evidence that there were rods over the top of the bent in the upper part of the slab. Such rods would be absolutely necessary in order to take the shear and to take the tension in the top of the slab due to the negative bending movement over the support. All the rods seem to lie so close to the bottom of the slab that their tearing out did not even leave any nicks visible in the photograph.

No doubt, in accordance with standard design, there were stirrups used to take the shear, an office alleged to be performed by stirrups; but how they do it no one has ever yet explained. It is plain that the shear of this empty bridge was not taken. It is also plain that the bent from which this span fell away did not sink, for it is seen to be in excellent alignment with the other bents in the left-hand photograph. It is plain, too, that the next bent did not sink away, for the bridge is seen to dip between these bents in all three pictures.

If the design of the bridge is what the photographs appear clearly to show, the failure was due simply and solely to bad design. The responsibility is on the profession because of its guilt in adopting such standards.

Pittsburgh, Penn. EDWARD GODFREY.

Placing Finish on Concrete Floors

Sir—Relative to my article, "Finish 3325 Sq.Ft. of Concrete Floor for 58c. per 100 Sq.Ft.," in your issue of April 4, p. 677, permit me to say that the article as published does not quite convey the desired analysis of the work in question. For instance, the two laborers mixing the material worked as a team and not one on the dry batch and the other on the wet batch. Only two or three dry batches were made up for the whole floor. The dry material was allowed to stand in the box and used as need to dry out the wet spots. One laborer working alone cannot mix a batch of finish very efficienly.

Another point which it was desired to bring out was the fact that a common laborer handled the big wooden float, and not a high-priced finisher. One of the laborers who roughened the floor was used for this purpose. The other laborer used on brushing the floor wheeled in the batches of finish, while the two men who did the mixing did nothing but mix the finish. The floor was also finished with a steel handtrowel .

JOHN T. SULLIVAN, C. E.,

Cincinnati. Roos Brothers Construction Co.

Kansas Counties Project Hard Road From Fort Leavenworth to Fort Riley

The commissioners of Wyandotte, Riley and Leavenworth counties, Kansas, have adopted a plan for a hard surface road intended to connect Forts Leavenworth and Riley. Shawnee and Douglas counties have likewise taken partial action, and little doubt is expressed that Jackson and Pottawatomie will shortly take similar steps. Final adoption by the several counties will insure the construction of the road. The specifications mentioned in the petitions call for concrete 8-in. thick at the center and 6 in. at the edges. The estimates put the cost at $18,000 per mile which will be divided as follows: Federal aid 15%; counties' share of the cost 42½%; township share of the cost 21¼%; the balance falling upon the benefited districts.

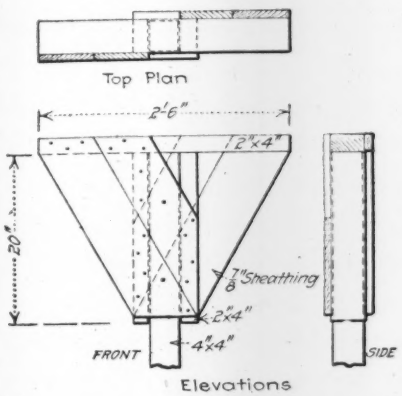
HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Shores with Detachable Heads Easy To Store and Ship

BY JOHN T. SULLIVAN
Roos Bros., Engineers and Concrete Contractors, Cincinnati, Ohio.

THE detachable head for form shores shown in the sketch makes it easy to store and ship the shores because of the space saved. One of the heads is slipped over a 4 x 4-in. post and nailed to it with double-headed



HEADS SLIP OFF EASILY FOR SHIPMENT

nails, which can be quickly pulled. This makes as rigid a construction as the ordinary shore, while when the forms are taken down the posts can be compactly piled in one place and the heads in another.

Locomotive Crane Coals Itself With Elevated Platform

IT IS hard to pass coal from the ground to the bunkers of a locomotive crane, and coaling one takes a good deal of labor where such shoveling is necessary. Yet the expense is not so great as to warrant any elaborate preparations to avoid it. C. D. Morley, in charge of the Unit Construction Co.'s contract for erecting concrete houses for the Youngstown Sheet and Tube Co., described on page 695 of *Engineering News-Record* of Apr. 11, solved the problem by using the light stage shown in the photograph. Coal on this work must be delivered by truck, as it is on top of a hill some distance from a railroad. After the coal is dumped on the ground, a laborer shovels it into a yard dump bucket. When the crane is not busy, it runs up the track, unloads this bucket and sets it on the ground again for the laborer to refill. Or the crane may take a little time off for coaling and a small gang may be used. With the platform full of coal, it is an easy matter to shovel it down into the crane and fill up the bunkers. Still less labor would be needed were the job one on which the crane was using a grab bucket, as it would load

EASY TO SHOVEL COAL FROM PLATFORM INTO CRANE

the platform itself in a few minutes. At Youngstown, however, the crane is employed in handling precast slabs, and it would not pay to keep a grab bucket on the job, much less to stop every time the crane needed coal to rig it up and take it off again.

Steam Shovel Carried 38 Miles on 5-Ton Motor Truck

BY STEDMAN BENT
Philadelphia

MOVING an 18-ton steam shovel a distance of 38 miles over country roads on three 5-ton platform trucks, and accomplishing this in eleven hours, certainly constitutes a record and demonstrates what may be done when circumstances prompt unusual methods. When, furthermore, steam was kept in the boiler the full time and the shovel ready to operate within seven hours after delivery, the record made is even more startling.

The occasion for this unusual test was brought about because one of the general contractors for the United States Government, in building a new bag and shell loading plant, needed a steam shovel and needed it badly and quickly. One was found in Philadelphia in the possession of a general contractor, and the Government officials proposed that I undertake the moving.

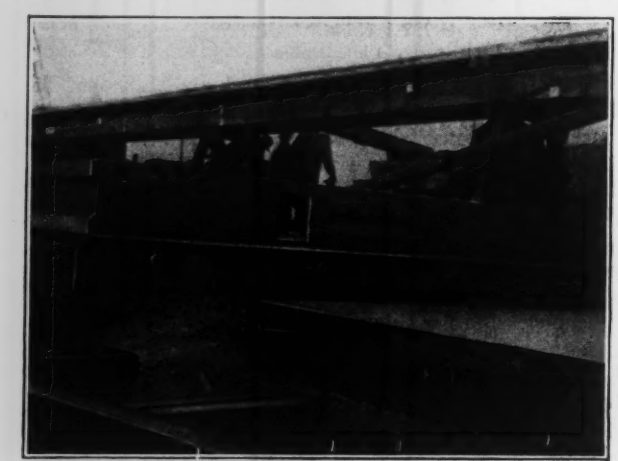
Jacking the shovel up, the running gear was taken from under it and loaded on one of the trucks which happened to be provided with a winch. While the shovel was in this jacked-up position a second 5-ton truck was backed under it. The body of the shovel was let down upon the truck, the boiler still being under steam pressure. The bucket, the dipper stick and boom

STEAM PRESSURE KEPT UP DURING 11-HOUR JOURNEY

were loaded on a third truck. About three o'clock in the afternoon the motor train left Philadelphia over country roads. At two o'clock the next morning, steam still being in the boiler of the shovel, the destination was reached and cribbing was built under the shovel body. The running gear was taken off the second truck and placed under the shovel body, which was let down upon it. The boom, dipper stick and bucket were in position and the shovel was ready for operation by ten o'clock.

Granulated Slag Used to Form Wall Holes Washed Out With Hose

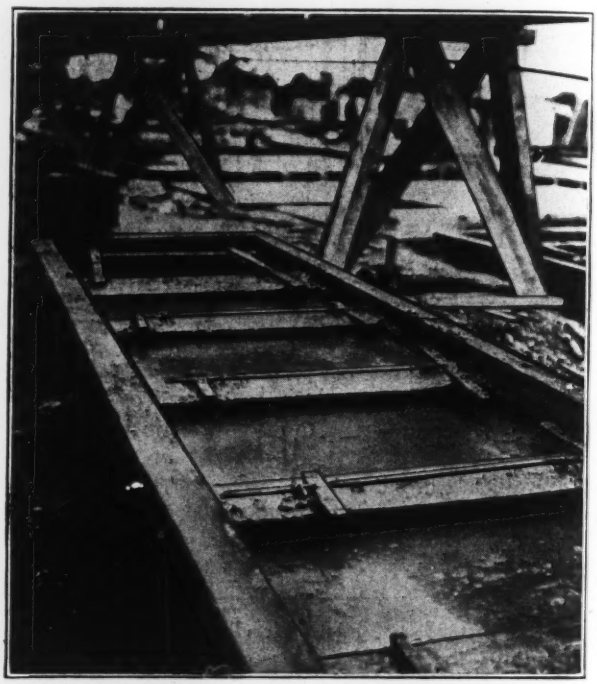
SLABS for party walls of the concrete workmen's houses being built by the Youngstown Sheet & Tube Co. are hollow and are formed with granulated slag, which after the concrete has hardened can be washed out of the holes with a small water jet. The holes are 2½x12 in., and extend clear through the slab.



GRANULATED SLAG WASHES OUT EASILY

The slabs are cast flat, as described in the account of the work on page 695 of *Engineering News-Record* for Apr. 11, the concrete being deposited first up to the level of the bottom side of the holes. Light wood forms, consisting of a pair of 1x2½ in. strips, braced apart, are then set for each hole, and the ribs between are filled with concrete up to the top of the strips.

As soon as this concrete takes an initial set these small forms are removed and the troughlike depressions left are filled with granulated slag and smoothed level. The top face of the slab is then completed, the concrete bonding readily with the ribs previously poured. After the outside forms are stripped it is easy to wash out the slag with a short piece of ¾-in. pipe on the end of a



FORM READY FOR SLAG TO BE PLACED

hose, using city water pressure. A hole which varies at any point less than ¼ in. from the designed section is formed by this process.

The work is being carried out for the owners mentioned by the Unit Construction Co., with C. D. Morley as superintendent.

Thawing Frozen Hydrants at Danville

Thawing frozen hydrants was reported on by H. M. Ely, superintendent of the Interstate Water Co., Danville, Ill., at the recent meeting of the Indiana Sanitary and Water-Supply Assn. A steamer made from a 40-gal. expansion tank mounted on a portable wood-burning furnace thawed the worst cases in from five to twenty minutes. The tank was equipped with a safety valve set at low pressure, and had sufficient ½-in. hose to reach from the boiler to the bottom of the hydrant. None of the frozen hydrants was damaged by freezing during the past winter.

NEWS OF THE WEEK

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Bills to Relieve New York Contractors Pass Legislature

The New York State Legislature has passed two bills designed to make it possible for the state and municipal governments to readjust contracts which have been seriously affected as a result of the war. The first bill, introduced with the approval of the contractors, would apply to all state, county and municipal contracts with the exception of those of the State Highway Department, and goes direct to the Governor for his signature. It makes it possible for the existing contracts to be cancelled, payment of cost of the work since this country entered the war being made to the contractor; and further provides for the continuation of the work under a new agreement between the authorities and the contractor whereby the contractor will complete the work for actual cost. This eliminates all profit to the contractor since April 6, 1917.

The second bill, introduced at the instigation of the Public Service Commission for the First District, which has the New York City subway work, is an amendment to the Rapid Transit Act, and as such applies only to the New York City subway contracts. It is substantially the same as the first bill, except that the sum to be paid the contractor upon cancellation of the contract is a matter to be determined in each case, and that, being a measure affecting New York City directly, it must go to the mayor for signature before being submitted to the Governor. As the mayor has ten days to act on this bill, it is not considered likely that the matter will be finally settled before the end of the month. It appears at the present time that both bills are liable to become law, one governing the subway work and the other all the remaining state and municipal contracts for construction work now in force.

Both bills as finally passed provide that the Board of Estimate of New York City shall be a party to the adjustment of the New York subway contracts.

Urges Highway Construction

At a meeting of the Highway Traffic Association of the State of New York held Tuesday evening, Apr. 16, S. M. Williams, president of the Highway Industries Assn., urged the immediate resumption of road construction as a "win the war" necessity. Mr. Williams made the statement that a study of the present transportation situation would show beyond question that road construction would be ultimately, if not immediately, of vast benefit in both a military and economic direction.

Chamber of Commerce Discusses Engineering Subjects

Industrial Relations, Transportation and Ship Construction Occupy Attention of Sixth Annual Convention in Chicago

Fully impressed with the necessity for doing everything of which they are capable, individually and collectively, to increase war production, 3000 business men left Chicago last Friday after attending an annual meeting—the sixth—of the U. S. Chamber of Commerce, which was dominated by engineering questions involved in the conduct of the war.

"What is not for the common good is not for the good of business" is the summary of the spirit of the convention made by the chamber itself. The general conduct of business, industrial relations and labor were considered at length under the heads of war production and shipbuilding.

After a preliminary meeting April 9 of the National Councillors, the convention opened April 10 with the presidential address and the reports of the war service committees on shipping, finance, government organizations and railroads. The chamber was addressed in the evening by the Secretary of Labor and the Secretary of Agriculture.

The next day the members, divided into four groups, considered government organization, war production as affected by industrial relations; finance; railroad and highway transportation, and shipbuilding.

Wheeler Elected President

On the last day of the convention the election of officers resulted by unanimous vote in the choice of Harry A. Wheeler as president; Joseph Defrees was elected vice president from the Northern Central Division, while the retiring president, R. G. Rhett, was elected, and Charles Nagel, A. B. Farquhar and John H. Fahey were re-elected honorary vice presidents. John J. Edson was re-elected treasurer.

Resolutions were adopted, one of which urged upon the Director General of Railways that the operation of the railroad terminal systems in each city be placed under the control of a single competent individual. The board of directors of the chamber was requested to call a conference representing all interests of the nation to consider the transportation problem, and formulate a basis for the control of transportation facilities after the conclusion of present Government operation.

The convention urged that the Government be petitioned to organize and operate existing equipment and to construct new equipment for inland and coastal waterways, as well as to complete highways for heavy traffic where they can be used to relieve railroad congestion. A permanent policy assuring coördination of railroads, waterways and highways was advocated. The resolution pointed out that a successful prosecution of the war requires the immediate use of rivers, canals and highways to move freight.

Water-power development was urged as an immediate necessity and Congress was called upon to pass the necessary legislation at once.

Recommendations on Shipbuilding

On the subject of shipbuilding the convention went on record as realizing that the present critical aspect of the war requires the United States to make the utmost possible contribution, and recommended that all local business organizations see that shipyards have the first call upon the best labor and executive ability available. The convention supported the new recommendation of the Emergency Fleet Corporation to Congress for an appropriation of $50,000,000 to begin the construction of concrete ships.

With reference to public utilities, it was recommended that state and local authorities recognize the onerous conditions under which they now have to operate and give prompt and sympathetic hearing to petitions for assistance and relief.

The regulation of exports through licenses and permits was dealt with by approving resolutions of the War Industries Board. The latter was requested to declare what industries are essential to the conduct of the war.

It was declared that the fixing of prices and control of excess profits by taxation should go hand in hand, it being stated as the belief of the convention that present tax laws should be amended if they prove inadequate to prevent excessive profits as a result of the war.

The central control of Government war buying was advocated in a resolution which favored prompt action by Congress to give the President power to readjust the relations of the various departments and create new agencies with the object of establishing an effective central control.

A resolution dealing with experi-

ments in connection with war supplies urged that the Government procure articles of proved value which can be supplied in necessary quantities wherever the articles are needed for immediate use.

Schwab In Charge of Shipbuilding

Charles M. Schwab, chairman of the board of directors of the Bethlehem Steel Company, on Apr. 16 was appointed by the United States Shipping Board to be director general of the Emergency Fleet Corporation, with complete supervision and direction of the work of shipbuilding. In announcing the appointment the Shipping Board issued the following statement:

"Charles Piez, vice-president of the Emergency Fleet Corporation, has recommended that the post of general manager of the corporation be at once abolished, so that Mr. Schwab, as director general, should be wholly unhampered in carrying out the large task intrusted to him. Mr. Piez, since the retirement of Admiral Harris, has been filling both the position of vice-president and that of general manager.

"Mr. Schwab will have complete supervision and direction of the work of shipbuilding. He agreed to take up this work at the sacrifice of his personal wishes in the matter. His services were virtually commandeered. His great experience as a steelmaker and builder of ships has been drafted for the nation."

Shipyards' Electric Car Problems Intrusted to Taylor

Travel to and from the shipyards by means of electric railways is the field of operations of A. Merritt Taylor, who has accepted the task of solving some of the transportation problems which confront the Emergency Fleet Corporation. Mr. Taylor, interviewed in Washington, said he hoped to bring to the Capital a number of engineers to assist in the work. There are now 145 shipyards on the Atlantic, Pacific and Gulf coasts, and many of them have transportation problems which require solution.

Mr. Taylor is well known to electric traction men throughout the country, especially as the author of the "Taylor Plan" for the new subway and elevated lines of Philadelphia. He was born in 1874, near Burlington, N. J., and began his career as an indentured apprentice in the machine shops of William Sellers & Co., Philadelphia. Soon after attaining his majority he engaged in the handling of investment securities, and at the age of 24 he was elected president of the Philadelphia & West Chester Traction Co. Later he became interested in other trolley lines in northern New Jersey, and in May, 1912, he was asked by the Mayor of Philadelphia to investigate the Philadelphia trolley situation. The result was the "Taylor Plan." He was appointed the first director of the newly created Department of City Transit, and held the office until January, 1916.

What the Army Engineers Have Done in One Year

Since the War Started Corps of Engineers Has Multiplied Its Work Fifteen Times

Engineers everywhere know what an enormous increase of work was thrust on the Corps of Engineers of the army by the entry of the United States in the war. A brief outline of the figures and facts of this increase is given in an official statement recently published by the Committee on Public Information. The following paragraphs are extracts from the statement:

"At the declaration of war with Germany the personnel of the various offices of the Engineer Department consisted of 177 officers and civilian employees. This force has been augmented until at the present time it consists of 2818 officers, enlisted men, and civilian employees.

"At the beginning of the war the engineer troops consisted of three regiments of pioneer engineers, with trains, one mounted company, one engineer band, and an engineer detachment at West Point. The aggregate strength was approximately 4125 officers and enlisted men. At present the aggregate authorized strength is over 200,000, with an actual strength of approximately 120,000.

Organization of Units

"Units of the following classes have been organized: Divisional engineers (sappers), mounted engineers (sappers for operating over extended territory), forestry (for lumbering and operation of sawmills), railway construction, railway operation, railway maintenance, and railway shop engineers, road (highway construction and maintenance), supply and shop (general supply, including all supplies except those for railway repairs), general construction (buildings, wharves, docks, etc.), mining (military mining), quarry (for obtaining stone to be used in engineering construction), surveying, ranging, and mapping (topography, mapping, and sound and flash ranging), gas and flame, electrical and mechanical (installation and operation of electrical and mechanical plants), water supply, motor transportation, searchlight (for battle-front illumination, assistance in transportation, and use against aircraft), pontoon bridge, clerical, labor service, replacement troops, crane operators (port terminal service), camouflage, and storekeepers and miscellaneous trades.

"Of the special engineer units recruited for service on railways and in the maintenance of lines of communication, many are already in France and others are awaiting recruitment to full strength in order to be ready for overseas service. The first engineer troops, 1100 strong, to be sent abroad, arrived in France about three months after war was declared. Since that time the number has been greatly augmented. These troops have been constantly engaged in general engineering work, including the construction of railways, docks, wharves, cantonments, and hospitals for the use of the American Expeditionary Force. They have, in some instances, in the performance of their duties, engaged in active combat with the enemy.

Engineer Reserve Corps

"The Engineer Reserve Corps, authorized June 3, 1916, was small prior to the war, but immediately applications were received in great numbers. There has been, up to the present time, a total of over 20,000 applications for commissions in the Engineer Reserve Corps, and from this number approximately 5500 have been selected as being fit for the duties required.

"There are now in the Corps of Engineers, including the Regular Army, National Army, National Guard, Engineer Reserve Corps, and Railroad Transportation Corps, about 6500 officers on active duty and approximately 100 reserve officers on inactive duty. Many of those on inactive duty are old and well-known engineers and specialists who are retained on the inactive list in order that they may be available for consultation and for the solution of special questions which may be referred to them from time to time.

"The office of the Director General of Military Railways, from the beginning of the war to Feb. 20, 1918, had placed orders for railway supplies having an aggregate weight of 754,000 long tons and a value of about $142,000,000.

The General Engineer Depot, from April 1, 1917, to Jan. 31, 1918, had issued a total of over 9500 orders for material, with a value of about $202,000,000. As the General Engineer Depot acts, to a certain extent, as disbursing office for the Director General of Military Railways, the amount given as expended by the depot includes in great part the railway material above mentioned."

Army Needs Men for Cantonment and Camp Utilities

Names of men who can be commissioned and assigned to duty at various army camps in connection with the maintenance and operation of utilities, are desired by the construction division, quartermaster corps, National Army. Men with the necessary qualifications to take charge of electric lighting, water supply, road construction, steam-heating plants, building repairs, etc., are asked to communicate with Lieut.-Col. Philander Betts, construction division, quartermaster corps, National Army, 7th and B Sts., Washington, D. C.

In a number of cases, some of the officers already commissioned have failed to develop the requisite ability to organize and control the necessary forces, which range from 200 in a National Guard tented camp to 700 men in a National Army cantonment, where there are a number of regimental steam-heating plants besides a large

central steam-heating plant at the base hospital, which in most cases will shortly have the completed capacity of 1500 beds.

Applicants for commissions should be above the draft age, and in addition to their technical knowledge should have capacity for team work, and for working under discouraging conditions.

American Engineers Helped to Hold Germans Before Amiens

A correspondent of the London *Daily Mail* says that American railway engineers played a prominent part in the gallant defense put up by General Carey's improvised army, which prevented the enemy from pushing through to Amiens in the first few days of the great attack. The improvised force held an important stretch of the front against powerful German assaults.

"There was no doubt in anybody's mind that they would hold on grimly as long as breath remained in their bodies," says the correspondent. How the men were assembled before daylight, made up into companies and battalions by noon, and were ready to march shortly afterward, is told by him:

"It was not until it had been in the field for some time that the force was able to get artillery. As soon as they had it they certainly used it to good advantage; in the beginning, however, it was the men who held the enemy back with their bodies."

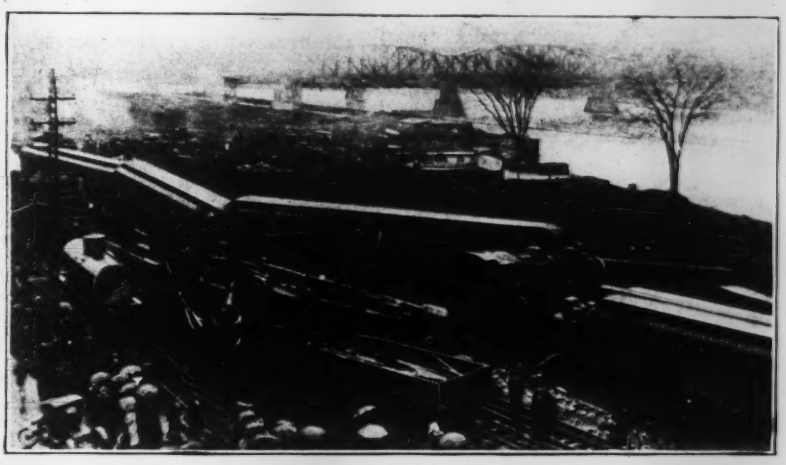
Putting Cleveland Water Filters in Operation

Foundation settlement defects in the water-filtration plant for Cleveland, Ohio, have been sufficiently overcome to permit the plant being put in operation up to about two-thirds of its designed capacity Apr. 12. The present average daily water consumption in Cleveland is about 110,000,000 gal. Of this about 100,000,000 gal. will be filtered from now on and about 10,000,000 gal. of unfiltered water will be pumped by the east side station at Kirkland St. On Mar. 16 the filter plant was started in operation to the extent of supplying 33,000,000 gal. daily. This was gradually increased to 68,000,000 gal. and then raised on Apr. 12 as stated above. The plant was originally designed to give a capacity of 150,000,000 gal. per day from 36 filter units.

The maximum amount of water used by Cleveland was 163,000,000 gal. on Feb. 6, when the temperature was below zero. On that day the total pumpage was 157,000,000 gal., the balance of the consumption coming from storage. Because of the growth of the city and the possible inability of the west side filtration plant to meet the entire demand, the city proposes to start construction of the proposed east side filter plant soon. J. W. Ellms, who has been dividing his time between the supervision of water filtration at Cincinnati and Cleveland, will give all his time to Cleveland beginning May 1. He will have charge of the operation of the west side water-filtration plant and also of the design of the new east side plant from the purification as contrasted with the structural side.

Engineering Photography Depicts Triple Train Wreck

Not because civil engineers as such are vitally interested in railroad collisions is the accompanying photograph shown, but because the performances of the three trains involved were so unusual and because the civil engineer who furnished the photograph so evidently perceived the opportunity to tell the whole story with one picture taken from the right spot.



PERFORMANCE OF THREE TRAINS IN COLLISION SHOWN BY ONE PICTURE

The triple wreck occurred Apr. 8, near Amsterdam, N. Y., on the New York Central R.R. Several cars on an eastbound freight train on track 4, the remains of which are seen in the foreground of the picture, were derailed by a broken truck, spreading across tracks 3 and 2, for westbound freight and passenger service, respectively. Train 51, the Empire State Express, running on track 2, struck the wreckage. Its locomotive turned over and appears in the foreground, across a gondola. Its tender and coaches were thrown toward the river, and were struck by eastbound passenger train No. 16, running on track 1. The locomotive of No. 16 has turned a right angle without material damage to the rest of the train, or apparently without much additional damage to No. 51. The tender and first coaches of No. 51 are seen beyond No. 16.

Only one death, that of the engineman of No. 51, was caused.

F. E. Crane, civil engineer, Amsterdam, N. Y., furnished the photograph.

Return Loads Bureau for New York City

Following a request from the Highway Transport Committee of the Council of National Defense, the Merchants' Assn. of the City of New York has appropriated $5000 for the establishment of a return loads bureau in that city. This innovation in the commercial use of the highways has been receiving much attention recently. In *Engineering News-Record* of Apr. 4, p. 688, mention was made of the campaign inaugurated by the U. S. Chamber of Commerce to promote the establishment of such bureaus.

It is asserted that much relief to the railroads is being afforded by commercial motor truck deliveries of commodities. No doubt the cost of such service is reduced by providing revenue producing loads for return trips rather than letting trucks go back empty to their points of origin.

Contractor Loses Mare Island Dry-Dock Decision

Claim made by the Atlantic, Gulf & Pacific Co. for $470,700.44, representing cost plus profit in dry-dock construction at Mare Island, Calif., has been denied by the Court of Claims, and judgment rendered against the company for court costs. The court, however, dismissed the Government counterclaim of $489.22 for the excess cost of completing the dry-dock.

In 1899 the Atlantic, Gulf & Pacific Co. contracted to construct a timber drydock for $729,000. The following year an act of Congress changed the requirements from timber to concrete and stone construction. A supplemental agreement was made to cover the increased cost, the price being raised to $1,125,233.83. In 1903 the cofferdam gave way completely, which made it impossible to finish the dock at a profit within the contract price.

Indianapolis Sewage Disposal Plan Adopted

Plans for sewage disposal have been adopted by the Board of Sanitary Commissioners of Indianapolis and Apr. 24 has been set as the date for public hearing at which objections may be sub-

mitted in accordance with the statute creating the commission. The method of disposal is Project 3-A, recommended by George W. Fuller, consulting engineer, New York City, in his report, which was abstracted in *Engineering News-Record* of Nov. 22, 1917, p. 972. This project includes an intercepting sewer, a pumping station, grit chamber, fine screens, sprinkling filters and humus tanks, together with apparatus for pressing and drying the humus sludge for sale as a fertilizer. Application will be made to the capital issues committee of the Federal Reserve Board for approval of the necessary bonds for the plant. The members of the board are Henry W. Klausmann, city civil engineer, president; C.. H. Hurd, vice president; anad Jay Craven, secretary.

Col. Sullivan Confirmed on Advice of Boston C. E. Society

Col. Thomas F. Sullivan, whose appointment as commissioner of public works of Boston was noted in *Engineering News-Record* of Mar. 28, p. 637, has been confirmed by the Massachusetts Civil Service Commission. The delay in confirmation was due largely to the difficulty in reaching a decision whether or not Colonel Sullivan is "a civil engineer of recognized standing in that profession," as required by a city ordinance. Although he has been roadmaster of the Boston Elevated Railway for many years, Colonel Sullivan is not a member of any engineering society, leaving the street railway associations out of consideration. The Civil Service Commission asked the assistance of the board of government of the Boston Society of Civil Engineers, which made a thorough investigation through a committee of past presidents, and reported that in its opinion Colonel Sullivan is an engineer of recognized standing as required by the ordinance. *Engineering News-Record* is informed that the board of government of the society recognized that in undertaking this inquiry it was entering upon a matter which might be delicate and even unpleasant, but the members felt that it was a public duty which could not be avoided.

ENGINEERING SOCIETIES

The Summit Society of Civil Engineers was recently organized, with headquarters in Akron, Ohio. Charles Fish is president and G. E. McCurdy is secretary and treasurer. The active membership is composed of practicing engineers and surveyors and the associate membership will include engineers engaged in public work for the cities, villages and state in Summit County. The objects of this organization are to promote the interests of the engineering profession in this territory and to coöperate with other organizations for the betterment of civic conditions. The society has already started an active campaign for the preservation of monuments and the filing and standardizing of surveys for street and road improvement. In this connection also the society is endeavoring to show public and private organizations the value of the engineer's work and the need of making careful engineering studies before starting any important improvement.

Calendar

Annual Meetings

AMERICAN WATER-WORKS ASSOCIATION; 47 State St., Troy, N. Y.; May 13-18, St. Louis, Mo.

AMERICAN ASSOCIATION OF ENGINEERS; 29 South La Salle St., Chicago; May 14, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS; 29 West 39th St., New York; Spring meeting, June 4-7, Worcester, Mass.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS; 129 York St., Brooklyn, N. Y.; June 19-22, Berlin, N. H.

AMERICAN CONCRETE INSTITUTE; 27 School St., Boston; June 24-26, Atlantic City, N. J.

AMERICAN SOCIETY FOR TESTING MATERIALS; University of Pennsylvania, Philadelphia; June 25-28, Atlantic City, N. J.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS; 29 West 39th St., New York; Atlantic City, June 26-28.

The Apr. 20 meeting of **The Pittsburgh Section of the Association of Iron and Steel Electrical Engineers** will be addressed by W. S. Scott, of the Westinghouse Electric & Mfg. Co., on "The Electric Furnace for Annealing Treatment and Forging of Steel." On Apr. 27 **The Cleveland Section** will hear a paper on "Electric Soaking Pits, Annealing and Heat Treating Furnaces and Furnaces for Melting Non-Ferrous Metals," by T. F. Bailey, president of the Electric Furnace Company.

At the meeting in Denver, Apr. 13, of **The Colorado Association of Members of the American Society of Civil Engineers** Arthur O. Ridgway, assistant chief engineer of the Denver & Rio Grande R.R., spoke on "Our Railroads in War Times." Mr. Ridgway presented the general railway situation as follows: (1) The standing of the railways of the United States among the world's railways in extent of physical property, capitalization, public service rendered and return to the owners; (2) the physical condition and traffic burdens of the United States railways since the beginning of the war and up to the time that federal control became effective; (3) the significance of federal control and its effect on federal valuation, and particularly on engineering.

There was a joint meeting of the **Minnesota Section** of members of the **American Institute of Electrical Engineers, American Society of Civil Engineers, St. Paul Society of Civil Engineers and Minneapolis Engineers' Club** in the auditorium of the main engineering building of the University of Minnesota, Apr. 9. A. F. Meyer, president of the St. Paul Civil Engineers' Society, presided. The occasion of this joint meeting was the reading of a paper by Daniel W. Mead on methods of increasing the output of hydro-electric plants. Mr. Mead's talk was illustrated with lantern slides of photographs and diagrams showing economies to be worked out in modern water plants. He began with the value of storage reservoirs, faulty construction of tail races, intakes and trash screens, with input and output curves for various conditions and graphical analyses of the efficiency of various types of plants. Photographs of tail race and head race conditions at various plants were shown, and a vertical cross section of late installations, together with a tabulation of the increase in efficiencies of various types of water wheels, from the old 30-inch design to the present modern turbine installation. The discussion was led by F. E. Thian, president of the Northwestern Association of members of the American Society of Civil Engineers, and Francis E. Shenehon, consulting hydraulic engineer.

Patriotism marked the meeting and dinner given by **The Springfield, Ill., Engineers' Club** Apr. 3. E. R. Shepherd of Washington, D. C., associate engineer of the U. S. Bureau of Standards, gave an illustrated talk on the bureau's work.

Mrs. Ada Ward, English humorist and cartoonist, on Apr. 11 addressed members of **the Chicago Engineers' Club.** She drew some of the cartoons with which she used to amuse the Tommies at the front.

The Illinois Section of the American Water-Works Association held its regular spring meeting Apr. 16-17 at Urbana. Water waste elimination, rising costs of materials, cold weather difficulties, pump tests and public-utility problems were the subjects discussed.

The following officers of the **County Engineers Association of New Jersey** were elected to serve for the year 1918: James Logan, Burlington County, president; Garwood Ferguson, Passaic County, vice-president; Alvin B. Fox, Middlesex County, treasurer; T. J. Wasser, Hudson County, secretary.

Henry L. Doherty, president of Henry L. Doherty & Co., bankers and operators of public utility corporations, addressed **The Cleveland, Ohio, Engineering Society,** April 9, in the absence of W. H. Finley, chief engineer of the Chicago & North Western Ry. Mr. Doherty has been engineer or manager of gas, electric or traction companies in more than 25 American cities. In his address he held that the United States will win the war through organization and invention, in which America is foremost. He said he had gone to Cleveland to propose the organization of industry, only to find that it had already been done by the War Industries Commission. He urged

every local engineering society to make arrangements to encourage invention and sift the schemes that are offered, advocating those of merit and making them known to the Government. Mr. Doherty touched also upon many other phases of the war problems now confronting the army and navy.

On Apr. 23 the society will be addressed by Dr. R. H. Fernald, professor in charge of mechanical engineering University of Pennsylvania, on "Is Our Fuel Supply Nearing Exhaustion?"

The Civil Engineers' Society of St. Paul, Minn., on Apr. 8 was addressed by W. L. Darling, member of the special railway commission to Russia, who told of "Railway and Other Conditions in Russia."

PERSONAL NOTES

L. V. EDWARDS, professor of highway engineering, Washington State College, Pullman, Wash., has been engaged as assistant county engineer of Whitman County with headquarters at Colfax. He will be an assistant to County Engineer J. M. McCaw, and will act in the capacity of a consulting engineer. Mr. Edwards plans to resign from the college faculty immediately. More than $50,000 is to be expended on the roads of Whitman County during the year.

P. J. HURTGEN, who for the past five months has served as acting city engineer of Kenosha, Wis., was elected city engineer for the coming year by the common council Apr. 1. Mr. Hurtgen has been dividing his services between Burlington, Wis., and Kenosha but will give his entire time to Kenosha. Alfred Wood was elected first tween Burlington, Wis., and Kenosha, Ben Brennan, former city engineer, is now with the United States Army in France and his position is to be held open.

C. M. BAKER has resigned his position as assistant engineer with the New York State Department of Health, and has accepted an appointment as sanitary engineer in the U. S. Public Health Service. He is at present in Macon, Ga., engaged in work in connection with the control of malaria in the extra-cantonment zones.

HUGH H. LUMSDEN, recently employed as chief designer for I. G. Hedrick, consulting engineer, Kansas City, Mo., has accepted a commission in the cantonment construction division, National Army. He will report at Washington April 22. Mr. Lumsden has been chiefly engaged in construction work in connection with bridges and railroad terminal building construction for the past 12 years.

VICTOR H. COCHRANE, bridge engineer for Kansas City, Mo., and for several years a member of the firm of Hedrick & Cochrane, consulting engineers, has accepted a commission as major in the cantonment division of the Army, reporting to Washington Apr. 15. Mr. Cochrane was for several years chief draftsman for the firm of Waddell & Hedrick, and has been connected in various capacities with many bridges of importance in Kansas City and its vicinity.

A. LINCOLN FELLOWS, formerly engineer member of the Public Utilities Commission of the city and county of Denver, Colo., has opened an office for the general practice of engineering at Kemmerer, Wyo.

IRA A. KIPP, JR., of South Orange, N. J., has resigned as a member of the State Highway Commission. He has been succeeded by Samuel Haverstick, Trenton.

A. F. COTTON, New Westminster, B. C., has been appointed municipal engineer to succeed J. H. O'Hara, who resigned.

W. H. WINTERROWD has been appointed chief mechanical engineer of the Canadian Pacific Ry., succeeding W. E. Woodhouse, whose assistant he was. He was in the service of the Pennsylvania R.R. and New York Central R.R. before joining the staff of the Canadian Pacific Ry. 6 years ago.

MAJ. GEORGE RATHJENS, until recently commander of one of the battalions of the 313th Engineers, has been promoted to the rank of lieutenant-colonel of the regiment.

To CAPT. PHILIP J. MCCAULEY, of the 151st Field Artillery, has been awarded the Distinguished Service Cross, the newly created medal awarded by the United States for especial bravery shown in action. Captain McCauley is a graduate of Purdue University, and a member of the Civil Engineers' Society of St. Paul, Minn. For three years he was connected with the office of the Minnesota state drainage engineer, and since 1911 has been engineer in charge of Judicial Ditches Nos. 3 and 4 at Floodwood, Minn. He has been a member of the Minnesota National Guard for eight years, commanding Battery C of the First Minnesota Field Artillery. During the winter of 1916-17 he served on the Mexican border at Fort Sill, Texas. He is 33 years old.

J. C. ROCKWELL has been promoted from the position of manager of the light and power department to general manager of the Manila (P. I.) Electric Railroad & Light Co. Mr. Rockwell was graduated in 1914 from Cornell University with the degree of mechanical engineer. Following his graduation he engaged in track construction work. In 1906 he became superintendent of transportation of the Syracuse (N. Y.), Lakeshore & Northern Railroad Co. He was appointed general superintendent in 1909 of the Charleston (W. Va.) Interurban Railroad Co., and the following year was elected general manager of this company. In 1911 he joined the operating organization of The J. G. White Management Corporation, New York City, and was assigned to the Manila Elec- organization of the J. G. White Manager of the light and power department. Mr. Rockwell has been on a visit to the United States and is now returning to Manila.

J. W. HANNA, chief engineer of the Kansas City Terminal Ry., will handle directly hereafter the work of the bridge department. George E. Tebbetts, bridge engineer, has gone to Washington, as noted in last week's *Engineering News-Record.*

H. G. FLURY, former office engineer in the bridge department of the Kansas City Terminal Ry., and recently with the American Bridge Co., at Gary, Ind., has accepted a position in the contracting department of the Kansas City Structural Steel Company.

H. E. STEVENS, chief engineer, will have charge both of the offices of chief engineer and of chief engineer maintenance of way of the Northern Pacific Ry., which were consolidated after the appointment of A. M. Burt as acting vice-president in charge of operation.

G. B. BRODE, secretary and general manager of the William Brode Co., general contractors, Newcomerstown, Ohio, has received a leave of absence for the period of the war, and has accepted a commission as captain in the Quartermaster Corps, National Army, and has been assigned to dock and terminal warehouse construction at Charleston, S. C. E. C. Johns, assistant superintendent for the company, has also received leave of absence for the period of the war and is with the Twentieth Engineers in training at Washington, D. C.

W. L. MILLER, city manager of St. Augustine, Fla., resigned recently to accept a position in New York City. He has been succeeded by Eugene Masters, former mayor of St. Augustine. Mr. Miller has been city manager of the Florida city since Aug. 1, 1915.

JEROME L. CHENEY, Syracuse, was nominated by Governor Whitman for member of the Public Service Commission of the State of New York, Second District, and was confirmed by the Senate Apr. 12. Mr. Cheney succeeds the late William T. Emmet. He is a lawyer.

MAURICE M. WILLIAMS, terminal engineer in the office of the New York State engineer and surveyor, has resigned to become consulting engineer in the department of the Quartermaster General at Washington. He will have charge of construction and detail work on the various ports of embarkation and the work on the expeditionary depots along the Atlantic coast on which the

United States is about to expend more than $200,000,000. Mr. Williams will be directly under General Goethals. He has been engaged in the planning and detail work of freight handling on the various state barge canal terminals since Jan. 1, 1915. He is a graduate of Colgate University.

WILLIAM A. STICKEL, assistant county engineer of Essex County, New Jersey, has received leave of absence for the duration of the war. He has entered the engineering department of the navy as a chief petty officer.

WADDELL & SON, INC., has moved its New York offices to 35 Nassau Street.

CAPT. JOHN P. HURLEY, Company K, 165th Infantry, reported Apr. 11 as slightly wounded in action, is the senior company commander in his battalion and has taken the command of Maj. Timothy J. Moynahan, who was slightly wounded in action about Mar. 28. Captain Hurley was a member of the 69th Regiment, New York National Guard, for several years and served with it on the Mexican border in 1916. He was a member of the engineers' staff of the Public Service Commission, New York City, and the Highways Department of the city, and did much of the engineering work in the border camps. He is 39 years old and a resident of Brooklyn, N. Y.

E. L. SPARKS, industrial editor of *Engineering News-Record*, has left the staff to become New England representative of the Ball Engine Co., steam-shovel manufacturers of Erie, Penn. From 1902 to 1914 Mr. Sparks was engaged in railroad construction work in the Southwest, being appointed assistant engineer maintenance of way on the Tucson division of the Southern Pacific Co. in 1906. In 1914, Mr. Sparks joined the staff of *Engineering Record* in the advertising service department, and in 1917 became industrial editor of *Engineering News-Record.*

J. W. ELLMS, superintendent of filtration, in charge of the water purification works of Cincinnati, has resigned to become engineer of water purification, Cleveland, Ohio, waterworks. He will have full charge of the West Side filtration plant, and will assist in the designing of the proposed East Side water purification plant. Besides holding his public office in Cincinnati, Mr. Ellms has been engaged in practice as a consulting engineer.

PROF. GEORGE F. SWAIN, who has been speaking in the West, returned to the Massachusetts Institute of Technology with the degree of LL.D. conferred on him by the University of California.

PROF. F. H. NEWELL, head of the department of civil engineering of the University of Illinois, is the recipient of the Cullum Geographical medal awarded by the American Geographical Society of New York. The last one to receive the honor was Gen. George W. Goethals, in recognition of his services in connection with the Panama Canal. Others have been Admiral Robert E. Peary, Fridtjof Nansen, Sir John Murray, the Duke of the Abruzzi, Sven Hedin and Sir Ernest H. Shackleton.

The inscription on the medal reads: "Frederick Haynes Newell, organizer and director of the United States Reclamation Service, 1907-1914. He carried water from a mountain wilderness to turn the waste places of the desert into homes for freemen."

E. L. MOSLEY, assistant engineer valuation department of the Illinois Central R.R. Co., has been granted a leave of absence to accept the position of supervising engineer on the U. S. Government Explosives Plant "C," Nitro, W. Va.

C. I. ANDERSON, assistant engineer in charge of bridge and building section of the valuation department of the Illinois Central R.R. Co., has been granted a leave of absence to accept the position of supervising engineer on the U. S. Government Explosives Plant "C," now under construction at Nitro, W. Va.

EDWARD DE V. TOMKINS, consulting and constructing engineer, who has for the past seven years had offices in New York City, has moved to Chicago to take the general agency of the Cement Gun Co., Inc., Allentown, Penn., in charge of its midwest territory, with headquarters in Chicago. Mr. Tomkins was bridge engineer in charge of construction for the City of New York for six years, and during the past administration was deputy commissioner of the Department of Docks and Ferries of New York City. His previous commercial experience was as manager of the New York office of the Trussed Concrete Steel Co., manager of the Philadelphia office of the Columbian Fireproofing Co., and manager of the New York office of the Maine Electric Company.

W. NELSON SMITH, who was for some years electric traction engineer with Westinghouse Church Kerr & Co., and recently efficiency engineer of the American Agricultural Chemical Co., is connected for the time being with Sydney E. Jenkins & Co., engineers and constructors, Vancouver, B. C., as electrical engineer.

D. HUBBARD has been appointed division engineer of the Newark, Ohio, division of the Baltimore & Ohio R.R., vice C. R. Diemar transferred.

C. A. BROYHILL, who was city engineer of Normal, Ill., several years, has been elected again to the position by the city council, after an interval of a year.

S. E. BOWERS, assistant city park engineer, of Cleveland, Ohio, has been appointed head of the new division of underground works of the city.

OBITUARY

MAJ. EDWARD R. KINGLE, Engineer Corps, U. S. A., who died in France Apr. 9 of wounds received in action, graduated from West Point as an honor man in the class of 1915, and was commissioned a second lieutenant of the Corps of Engineers. His promotion had been rapid, and he was recently commissioned a major. He was born in Oregon and was appointed to the Military Academy from Texas. He served about a year at the Washington Barracks and accompanied a battalion of engineers to France with one of the earliest expeditionary contingents. His home was in Galveston, Tex.

ANDREW RINKER, former city engineer of Minneapolis, died recently in that city. He held office from 1871 to 1893, and is credited with a leading and active part in the development of the city utilities, notably street paving, water-works installation and the development of the sewer system. After leaving office in 1893 he went into commercial engineering for a time, and in 1896 became engineer for the Great Falls Townsite Co. in Montana. He laid out that city, and helped greatly, by tree planting and otherwise, to beautify it. He returned to the service of Minneapolis as city engineer in 1902 and continued in that office until 1913, when he retired to take up practice as a consulting engineer. Mr. Rinker was 69 years old.

WILLIAM C. MCDONALD, first governor of the state of New Mexico, died at El Paso, Tex., Apr. 11. He was born in Jordanville, N. Y., in 1858, and went west soon after his graduation from Cazenovia, N. Y., Seminary. In his early life he practiced as a civil engineer and surveyor. He served as governor of New Mexico 1912-16.

JOHN B. BROPHY, of the engineering staff of the Cornwall, Ont., Canal, died recently at Cornwall, Ont., following a stroke. He was formerly engineer of St. Peter's Canal, Nova Scotia.

JOSEPH HANREDDY, contractor, died at his home in Chicago, Apr. 9. He was born in that city in April, 1864. His earlier work in the contracting business was mainly paving, but later he undertook larger jobs. Among the more important works carried out by him were the Lawrence Ave. intercepting sewer and part of the Southwest water tunnel under the city, at Chicago; the Linnwood Ave. intake tunnel under the lake, at Milwaukee, Wis., and the Lake Union tunnel at Seattle, Wash.

NEWS OF ENGINEERING INDUSTRIES

FOR MANUFACTURERS WHO SERVE ENGINEERS AND CONTRACTORS

Export Trade Combinations Will Be Lawful

President Signs Webb Bill—Benefits to Be Derived Are Shown by Manufacturers' Attitude

Combinations of domestic manufacturers for the purpose of furthering the interests of American export trade are permitted by the Webb-Pomerene law, signed by the President. Under the terms of the law the provisions of the Sherman anti-trust law are nullified so far as export commerce is concerned. To enjoy the benefits to exporters stipulated in the bill, all associations engeged in export trade must file statements with the Federal Trade Commission within 60 days. The Federal Trade Commission is empowered to investigate and report on alleged cases of unfair competition and price depression in export trade with a view to stopping such practices through action of the Attorney General.

The conference report on the bill, which was presented to both houses of Congress, contained only minor changes, having the effect of excluding, from the comprehensive definition given in the section of "export trade," the selling of goods, wares and merchandising for resale, as well as for consumption within the United States or any territory thereof. Other amendments have the purpose of making clear the portions of the bill which actually define and limit the operations of associations formed under the provision of the act.

The satisfaction of manufacturers with the terms of the law was shown at the monthly luncheon of the American Exporters' Assn., in New York, where it was described as putting the United States in a most advantageous position to meet international rivalry after the war and as an effective means of combating the German cartel system, under which commercial and financial influences prospered in foreign countries prior to 1914. Gilbert H. Montague, counsel for the association, who had been active in obtaining the enactment of the bill, told of the benefits to accrue from the rights about to be given to shippers to employ "unified tactics" in meeting competition in foreign markets.

"The law as we have it," Mr. Montague said, "represents a really substantial achievement. It will allow two or more exporters to combine for foreign trade without infringing the anti-trust laws. We must regard this as an after-the-war measure. At the present time our manufacturers are in the position of making the goods, throwing down the finished products, and having them grabbed up in a twinkling. Under such circumstances it can hardly be expected that the manufacturers will reach out for foreign trade. The time, however, will surely come when the need of overseas markets for finished goods will be appreciated, and then we may expect to see the Webb law come to the aid of exporters."

McAdoo Restates Opinion on Building Operations

Secretary McAdoo, in a letter addressed to Samuel Gompers, president of the American Federation of Labor, makes plain that no general appeal has been made to property owners to discontinue the construction of homes and buildings during the period of the war. Secretary McAdoo's letter to Mr. Gompers follows:

"I have your letter of Feb. 18 inclosing a copy of a resolution adopted by the Building Trades Council of San Francisco, in which it is stated that I have been reported in the public press as having 'appealed to property owners not to construct any homes or buildings during the war.' This is entirely erroneous. I have said that building operations which are not required to protect the health or provide for the comfortable needs of our people, or to supply facilities necessary for the proper conduct of business essential to the successful prosecution of the war, should be postponed.

"As you know I have no authority to direct that building operations be curtailed. I have merely suggested that unnecessary building of that kind be postponed until the end of the war. Such postponement would, I am sure, help win the war, but every patriotic man must be determined by his own conscience in the matter and must decide for himself if he can postpone the erection of a contemplated building until the war is over. Compliance with this suggestion may cause some inconveniences which are to be greatly deplored, but such inconveniences are an unavoidable incident to war. The situation must be viewed from a national and not from a local standpoint."

Australia Needs American Equipment

Makers of all classes of equipment and supplies used by railways will be interested in a report just issued by the Bureau of Foreign and Domestic Commerce at Washington on "Railway Materials, Equipment and Supplies in Australia and New Zealand." It may be obtained for 25 cents from the superintendent of documents, Government Printing Office, Washington, D. C., and is one of many similar reports being prepared for manufacturers.

Fuel Priorities Fixed by War Industries Board

Railroad and Fuel Administrations Notified to Give Preference to Necessary War Industries

Through the issuance of Preference List No. 1, designating industries contributing directly to the war needs of the nation, the War Industries Board, headed by Bernard M. Baruch, has announced the priority to be followed in future deliveries of coal and coke. The railroad and fuel administrations have been notified that their full facilities must be made available for carrying out the program as directed. The regulations provide first for "essential" industries and second for the "nonessential," considering the country's actual needs and the amount of surplus fuel which can safely be spared. The statement issued by the War Industries Board follows:

"The board has, however, listed certain industries whose operation is of exceptional importance, measured by the extent of their direct or indirect contribution either toward winning the war or toward promoting the national welfare, and these industries will be accorded preferential treatment by the Fuel Administration in the distribution of coal and coke and also in the transportation of such coal and coke by the railroads.

"The same plan will be followed in according preferential treatment to war industries and plants in the transportation of raw materials and supplies required by them in their manufacturing operations, so that they may not be delayed or hampered in complying with priority orders issued against them governing their products.

"Preference List No. 1 is not complete in itself, but it will be noted that provision is made for certifying additional classes of industries and also individual plants whose operations are necessary as a war measure. In determining what industries or plants are entitled to be certified, two factors will control:

"1.—The relative urgency of the uses or purposes for which the product of the plant is utilized.

"2.—The per cent. of the product of the plant utilized in war work, direct or indirect, or work of exceptional or national importance. No plant a very substantial per cent. of whose product is not of exceptional importance can be accorded preferential treatment."

The preference list, which was prepared after consultation with the Fuel Administration, the Director General of Railroads, the chairman of the Shipping Board and other officials, is virtu-

ally a revision and extension of former priority lists of the Fuel Administration. The list contemplates protection for the airplane and shipping programs, together with the principal industries essential to the army and navy establishment.

Since no distinction is made as to the relative importance of the industries listed, all questions of this nature will be determined by the Requirements Division of the War Industries Board in conjunction with the various departments involved.

The verdict of the chairman of the War Industries Board will be final in all rulings made, subject only to revision by the President.

Preference List No. 1 includes the following: Aircraft plants, ammunition plants, army and navy cantonments and camps, small arms plants, chemical plants, coke plants, domestic consumers, electrical manufacturers, explosives plants, manufacturers of farm implements, steam plants, ferro alloy plants, fertilizer plants, firebrick plants, food plants, manufacturers of food containers, gas producing plants, gun plants, iron and steel plants, laundries, machine tool plants, mines and mining and periodicals, oil refineries and oil equipment manufacturers, newspapers well equipment plants, public institutions and buildings, public utilities, railways and railway equipment plants, shipbuilding plants, steel plants, canning plants and wire rope plants.

Military Course in Oxyacetylene Work to Be Established

For the purpose of supplying the great war demands for oxyactetylene welding and cutting operators, a course has been established at the military trade school, Washington Barracks, D. C. It will be opened May 1, when 60 men from the first replacement regiment of engineers will take up the study. The course has been carefully worked out, and will embrace a theoretical as well as a practical study of the subject.

The necessity for speed in the repair or demolition of various military structures has put new and unusual demands upon the process of oxyacetylene welding and cutting. Bridges damaged by shell fire may be repaired by the use of this process, or removal may be expedited for the building of a new structure. On the other hand, the ease and speed with which heavy members may be cut and the bridge rendered useless to the enemy has made the oxyacetylene torch a very efficient defense weapon.

Besides the school of oxyacetylene welding and cutting, there are now in operation at Washington Barracks schools of photography, lithography, blacksmithing, horseshoeing, auto repairing, internal combustion and gas engine work, machinery (both bench and machine work), carpentry, surveying and drafting.

These schools are organized for the first replacement regiment of engineers at Washington, D. C. They form part of a three months' training course, to which selected men, chosen from the National Army or by enlistment, are sent.

Timber for 400 Wooden Ships a Year from South

Southern Pine Association's Meeting Pledges Sufficient Supply to Government

Sufficient timber for 400 wooden ships a year is not beyond the capacity of the pine mills of the South, according to a statement made by W. J. Haynen, assistant lumber administrator for the South of the U. S. Shipping Board, at a mass meeting of the Southern Pine Assn., held in Memphis, Apr. 6. The meeting was attended by representatives of lumbermen from the Southern states, who pledged to the Government sufficient timber for future ship contracts let in Gulf and Atlantic yards, regardless of cost or inconvenience.

John H. Kirby, recently appointed the U. S. Shipping Board's lumber administrator for the South, told the meeting that the Southern pine mills will have completed, by July 1, timber deliveries for the first 238 ships contracted for by the Government. They will then be ready to take on new schedules.

Type of Ship

In discussing types of wooden ships, Mr. Kirby said: "If the Daugherty type of ship, the first two of which have recently been launched at Orange, Tex., is accepted as a model, Southern mills can deliver timbers sufficient for 300 or more ships a year, should that number of contracts be awarded by the Government. Of course there will be new contracts awarded in addition to the 238 on which shipyards are now working, but how soon or how many I do not know." The Daugherty boat referred to by Mr. Kirby is a 5000-ton vessel, requiring less than 1,500,000 ft. of timber, whereas the Ferris model, of 3500 tons, which was first accepted by the Government, calls for nearly 1,600,000 ft. The new type requires smaller timbers than the Ferris vessel, and of a size more readily obtainable from Southern forests.

Increasing Timber Deliveries

Mr. Haynen told how ship timber deliveries had been increased from 20 cars a day when he went to New Orleans as assistant purchasing agent to nearly 100 cars a day, the average rate of shipment now. Numerous changes in schedules were largely responsible for early delays in getting out timbers as rapidly as needed. These changes were necessary, Mr. Haynen explained, because construction was found defective as the building of the ships proceeded. "Shipyards of the country are now amply supplied with timber, however," said Mr. Haynen, "and operating full time, work at present being well within the original expectations."

Business Notes

The Lakewood Engineering Co., of Cleveland, has opened a district office in Milwaukee, with Fred T. Kern and J. N. Young, both formerly of Kern, Hunter, as its representatives.

The Chas. J. McCarty Co., Boston, Mass., has taken on the complete line of Rex concrete mixers and pavers.

R. W. Spofford, general manager of the Augusta-Aiken Ry. & Electric Corporation, Augusta, Ga., who is a retired officer of the United States Navy, has been called into active service. W. C. Callaghan, previously of the J. G. White Management Organization, New York City, succeeds Mr. Spofford as general manager.

The Buffalo Hoist & Derrick Co. has been organized and has taken over the plant, good will and stock of both the Buffalo Contractors Plant Corporation and the Ruddock Bucket Co., Cleveland. The company will design and manufacture "Buffalo" hoists, derricks and buckets.

The Murphysboro Paving Brick Co., of Illinois, has started to produce silica brick for blast furnace and steel mill work.

Heyl & Patterson, Inc., of Pittsburgh, Penn., announce the opening of a sales office at Room 209, 90 West St., New York City, in charge of Raymond E. Brown, contracting engineer, who will give particular attention to wharf, shipbuilding and other special cranes.

Trade Publications

The Economy Excavator Co., Iowa Falls, Iowa, presents a new catalog of its improved 1918 "Economy" dragline excavator for trenching, ditching, grading and handling material. Various kinds of work are illustrated.

The Portland Cement Assn., 111 West Washington St., Chicago, has issued a new bulletin on the subject of concrete ships. This one is called "Progress in Concrete Ship Construction," and contains illustrations and descriptions of some of the more recent projects, giving a few detailed drawings of barges and ships.

The Layne and Bowler Co. has published a new bulletin under the title of "Railway Water Supply." The bulletin contains a number of illustrations and descriptions of water-supply equipment and machinery especially designed for a variety of railroad work.